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Ground Cloud Dispersion Measurements During the Titan IV A-17 Mission (7 November 1997) at Cape Canaveral Air Station

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Prepared for

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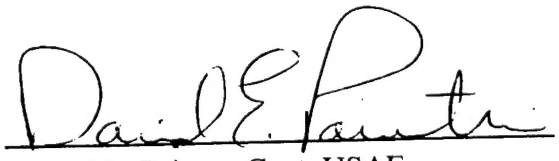

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Chief, Titan Systems and
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13. ABSTRACT (*Maximum 200 words*)

This report presents plume imagery documenting the development and dispersion of the Titan IV A-17 launch ground cloud at Cape Canaveral Air Station on 7 November 1997 at 2105 EST. Also presented are pertinent meteorological data taken from towers, Doppler radars, and rawinsonde balloons.

IR cameras were used at four locations around the launch site to track the trajectory and time evolution of the exhaust ground cloud for 7.5 min following launch. Meteorological data were collected to improve understanding of cloud dispersion and to use as input during model simulations and evaluations. Rawinsonde balloon data, 915 MHz Doppler radar data, and meteorological tower data were collected and archived. These data and similar data from other launches will be used to determine the accuracy of atmospheric dispersion models such as the Rocket Exhaust Effluent Diffusion Model (REEDM) in predicting toxic hazard corridors (THCs) at the USAF Eastern and Western Ranges.

Analysis of imagery data from the first 9.5 min following launch yielded information on cloud rise and dispersion. The imagery showed that the middle of the launch cloud stabilized at an altitude of 1192 m AGL by 4.25 min after launch. REEDM 7.08 predicted that the middle of the launch cloud would stabilize at 947 m AGL at 4.65 min after launch. The middle of the actual launch cloud therefore stabilized 26% higher than predicted by REEDM 7.08. Analysis of the imagery also showed that the rising cloud had an air entrainment coefficient (ratio of increase in diameter to increase in altitude) of 0.33 (REEDM 7.08 default value is 0.64). The initial cloud radius extrapolated from the imagery was 168 m. (REEDM 7.08 default value is 72 m). REEDM 7.08 predictions for bearing, speed, and stabilization height were closer to the observed values when REEDM was initialized with the imagery-derived for the initial radius and the entrainment coefficient rather than with the default values.

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Preface

The Air Force Space and Missile Systems Center's Launch Programs Office (SMC/CL) is sponsoring the Atmospheric Dispersion Model Validation Program (MVP). This program is collecting launch cloud dispersion data that will be used to determine the accuracy of atmospheric dispersion models, such as REEDM, in predicting toxic hazard corridors at the launch ranges. This report presents launch cloud dispersion and meteorological measurements performed during the Titan IVA-17 launch at Cape Canaveral Air Station on 7 November 1997.

An MVP Integrated Product Team (IPT) led by Capt. Bill Kempf (SMC/CLTE) is directing the MVP effort. Dr. Bart Lundblad of The Aerospace Corporation's Environmental Systems Directorate (ESD) is the MVP technical manager. This report was prepared by Mr. Norm Keegan (ESD) and Dr. Lundblad from materials contributed by personnel participating in the A-17 launch cloud dispersion measurements.

Infrared imagery measurements were made of the launch cloud by Ms. Karen Foster, Mr. Gary Harper, Mr. Brian Kasper, Mr. Luis Ortega, Dr. Don Stone, and Mr. Jess Valero of The Aerospace Corporation's Environmental Monitoring and Technology Department (EMTD). Mr. Doug Schulthess of Aerospace's Eastern Range Directorate coordinated camera site selection and logistical support. Also assisting imagery operations were Mr. John Ligda and Mr. Richard Reyes of the Aerospace Eastern Range Directorate. Ms. Foster digitized the imagery data for analysis by Dr. Robert Abernathy (EMTD). The description of the cloud imagery results was prepared by Dr. Abernathy.

The meteorological data displayed in this report was provided by Mr. Randy Evans of the NASA Applied Meteorology Unit.

The Titan IVA-17 mission was the thirteenth Titan IV launch for which usable launch cloud dispersion data was collected by MVP. The previous missions were K-7, K-23, K-19, K-21, K-15, K-16, K-22, K-2, K-13, B-24, B-33, and A-18.

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Executive Summary

This report presents plume imagery documenting the development and dispersion of the Titan IVA-17 launch ground cloud at Cape Canaveral Air Station (CCAS). The launch occurred on 7 November 1997 at 2105 EST. The report also presents pertinent meteorological data taken from towers, 915 MHz radars, and rawinsonde balloons.

The imaging team used infrared cameras at four locations around the launch site (LC-41) to track the trajectory and time evolution of the vehicle's exhaust ground cloud for 9.5 min following launch. Meteorological data were collected to improve understanding of cloud dispersion and to use as input during model simulations and evaluations. Rawinsonde balloon data from shortly before launch, radar data from shortly before and after launch, and meteorological tower data from shortly before and after launch were collected and archived. These data and similar data on other Titan IV launches (past and future) will be used to determine the accuracy of atmospheric dispersion models such as the Rocket Exhaust Effluent Diffusion Model (REEDM) in predicting toxic hazard corridors (THCs) at the USAF Eastern and Western Ranges. These THCs assess the risk of exposing the public to HCl exhaust from solid rocket motors or hypergolic propellant vapors accidentally released during launch operations.

Analysis of imagery data from the first 9.5 min following launch yielded information on cloud rise and dispersion. The imagery showed that the middle of the launch cloud stabilized at an altitude of 1192 m AGL by 4.25 min after launch. REEDM 7.08 predicted that the middle of the launch cloud would stabilize at 947 m AGL at 4.65 min after launch. The middle of the actual launch cloud therefore stabilized 26% higher than predicted by REEDM 7.08. Analysis of the imagery also showed that the rising cloud had an air entrainment coefficient (ratio of increase in diameter to increase in altitude) of 0.33 (REEDM 7.08 default value is 0.64). The initial cloud radius extrapolated from the imagery was 168 m. (REEDM 7.08 default value is 72 m). REEDM 7.08 predictions for bearing, speed, and stabilization height were closer to the observed values when REEDM was initialized with the imagery-derived for the initial radius and the entrainment coefficient rather than with the default values.

1. Introduction

Launch vehicles that employ solid propellant rocket motors release exhaust ground clouds containing large quantities of hydrogen chloride (HCl) into the launch areas at Cape Canaveral Air Station (CCAS) and Vandenberg Air Force Base (VAFB). Large quantities of hazardous liquid fuels and oxidizers could also be released as a result of propellant transfer accidents or launch vehicle failures. The Air Force uses atmospheric dispersion models to predict the downwind diffusion and concentration of toxic launch clouds. Collection of launch cloud data is required to test and validate the performance of these dispersion models.

The Air Force range safety organizations at Patrick Air Force Base (45 SW/SE) and VAFB (30 SW/SE) are responsible for assuring that launches occur only when meteorological conditions will not expose nearby public areas to hazardous levels of launch exhausts and propellant vapors. Predictions of toxic hazard corridors that extend into public areas can lead to costly launch delays. The use of non-validated models requires the use of conservative launch criteria. The development and validation of more accurate atmospheric dispersion models is expected to increase launch opportunities and significantly reduce launch costs. The Space and Missile Systems Center's Launch Programs Office (SMC/CL) established the Atmospheric Dispersion Model Validation Program (MVP) to collect launch cloud data and to use the data to test and validate current and future atmospheric dispersion models at the ranges.

The MVP effort involves the collection of data during Titan IV launches at CCAS and VAFB to characterize HCl launch cloud rise, growth, and stabilization, as well as launch cloud transport and diffusion. These data, along with data collected during tracer gas releases, will be used to determine the capability of the Rocket Exhaust Effluent Diffusion Model (REEDM) for predicting toxic hazard corridors at the ranges. REEDM is used at CCAS and VAFB to predict the locations of toxic hazard corridors in support of launch operations. It is applied to large heated sources of toxic air emissions such as nominal launches, catastrophic failure fireballs, and inadvertent ignitions of solid rocket motors. It uses launch vehicle and meteorological data to generate ground-level concentration isopleths of HCl, hydrazine fuels, nitrogen dioxide, and other toxic launch emissions. Launch holds may occur when REEDM toxic concentration predictions exceed adopted exposure standards. REEDM is a unique and complex model based on relatively simple modeling physics. It has a long development history with the Air Force and NASA, but has never been fully validated. Validation of REEDM has been identified as a range safety priority.

The MVP has been organized and is being directed by the MVP Integrated Product Team (IPT). SMC/CL is serving as the IPT leader, while The Aerospace Corporation's Environmental Systems Directorate serves as the IPT technical manager. The IPT consists of personnel with expertise in atmospheric dispersion modeling, meteorology, and atmospheric dispersion field studies. MVP participants include personnel from SMC, 30 SW, 45 SW, Armstrong Laboratory, The Aerospace Corporation, NASA, NOAA, and contractors. Key functions include program planning, field data collection, data review and compilation, range coordination, and model validation.

This report presents the results of measurements performed at CCAS during the Titan IVA-17 launch on 7 November 1997 at 2105 EST. Infrared camera imagery of the ground cloud was collected from four locations to monitor the cloud's growth, stabilization, and trajectory. The imagery results are presented in Section 2. REEDM predictions of ground cloud stabilization heights and surface concentrations are presented in Appendix A. Measurements of meteorological data are tabulated in Appendix B.

Analysis of the quantitative imagery determined the ground cloud's rise rate, stabilization height, expansion rate, bearing, and speed. The imagery-derived cloud stabilization height (middle of cloud) was 1192 m AGL. This is 26 % higher than the 947 m AGL height predicted by REEDM 7.08 (based on T-0.6 rawinsonde sounding). The measured cloud entrainment coefficient was 0.33, while the default value used in REEDM 7.08 is 0.64. Extrapolation of the imagery-derived sphere equivalent radius to ground level gives an initial cloud radius of 168 m (default value in REEDM 7.08 is 72 m). REEDM 7.08 predictions for cloud bearing, speed, and stabilization height were closer to the observed values when REEDM was initialized with the imagery-derived values for the initial cloud radius and the entrainment coefficient rather than the default values. The imagery results presented in this, as well as other MVP reports, will allow the accuracy of REEDM and other launch range atmospheric dispersion models to be determined over the range of possible meteorological conditions.

2. Imagery of the Titan IV A-17 Ground Cloud

[The material in this section was contributed by R. N. Abernathy, B. P. Kasper, and K. L. Foster of the Surveillance Technology Department of The Aerospace Corporation's Space and Environment Technology Center.]

2.1 Background

On 7 November 1997, the Titan IV A-17 mission was successfully launched from Space Launch Complex 41 (SLC-41) at Cape Canaveral Air Station (CCAS) at 21:05 EST (02:05 GMT). This section describes the quantitative exhaust cloud imagery data collected by each of four imagery sites during the 9.50 min immediately following the launch from SLC-41. This section also describes the data acquisition hardware and analysis software. The two-dimensional cloud images obtained by the various imagery sites were combined to produce stereoscopic 3-D information. This analysis yielded the cloud's rise rate, stabilization height, expansion rate, speed, and bearing during the first 0.25 to 9.50 min after launch.

The quantitative imagery-derived ground cloud data are reported here in several graphical formats to facilitate comparison with REEDM predictions (Appendix A) and rawinsonde sounding data (Appendix B). For clarity, this section includes some data from the appendices. It is apparent from review of this section, that these data are useful for validating current and future dispersion models.

The purpose of this report was to document the quality and quantity of the A-17 exhaust cloud imagery data available for validating dispersion models. To facilitate the comparison of these data to individual dispersion model runs, the imagery-derived A-17 exhaust cloud imagery data are available as comma-separated-variable files providing time and position for various ground cloud features. When collected, the raw visible imagery data are archived on VCR tapes. The raw infrared (IR) imagery is archived on DAT. The selected IR images analyzed for this report are also archived on magneto-optical disks as digital image files.

2.2 Introduction

This section summarizes the results of quantitative IR imagery of the exhaust cloud from the Titan IV A-17 launch from SLC-41 at CCAS on 7 November 1997 at 21:05 EST (02:05 GMT). Personnel from The Aerospace Corporation's Surveillance Technology Department (STD) supported this launch with the deployment of four complete platforms of the Titan IV dedicated Visible and IR Imaging System (VIRIS). For the A-17 evening launch, the IR imagery permitted the post-launch quantitative analysis of the ground cloud's movement and growth as a function of time.

The imagery sites chosen for the A-17 launch were

- on the road across from UCS-4
  (northwest of SLC-41),

- at the sixth bollard along the northeast edge of the pond at Press Site
  (west of SLC-41),

- at static test road viewing site (STR)
  (southwest of SLC-41), and

- on a rise in the road to the east of SLC-34
  (south-southeast of SLC-41).

UCS stands for Universal Camera Site. Each site recorded only IR imagery of the exhaust cloud since it was too dark for visible imagery.

The IR imagery was digitized by the AGEMA scanner at 13 bits by an internal A/D converter. Due to a bug in the acquisition program, only the least-significant six bits (i.e., the intensity was "folded" to six bits of intensity) were stored to hard disk. In addition, the acquisition program averaged 7 images of the cloud with 5 unrelated images. As a result of this second error, the analyst had to subtract previous or subsequent images to reveal cloud details. Luckily, the 5 unrelated images were identical and were completely eliminated by image subtraction. In addition, the image subtraction removed some of the elevation-dependent atmospheric radiance gradient. Interestingly, the "folded" and background-subtracted imagery revealed all of the ground cloud with a single intensity span. Normally, one can only view a portion of the 13 bits of intensity spanned by the ground cloud and the elevation-dependent atmospheric radiance. A down side to the image subtraction was that the exhaust cloud was in all imagery subsequent to launch. Therefore, the processed images can contain both positive and negative images of the ground cloud when subsequent imagery serves as background. By wise selection of the images, the positive and negative exhaust cloud images had minimal overlap and posed little difficulty for image interpretation.

Quantitative analysis of the IR imagery for the first 9.50 min after launch documented the cloud's rise rate, stabilization height, expansion rate, bearing, and speed without recourse to other data. The "ground cloud" is defined as the lower and more concentrated portion of the rocket's exhaust cloud that can diffuse to the ground. The "launch column" or contrail is defined as the trail of the rapidly moving rocket that extends above the more spherical "ground cloud."

The T-0.6 h rawinsonde pre-launch meteorology data are documented in Appendix B and referenced in this section. Those rawinsonde wind data were used to run the "normal launch" REEDM version 7.08 predictions. The complete output for the T-0.6 h REEDM version 7.08 "default" predictions are documented in Appendix A and referenced in this section.

2.3 Field Deployment

2.3.1 Planning

The Aerospace Corporation's participants are listed in various teams below (members of the imaging teams for A-17 are indicated with asterisks):

Technology Operations
Space and Environment Technology Center
Surveillance Technology Department (STD)
J. T. Knudtson, Director of STD

G. N. Harper*	(East of UCS-4)
K. L. Foster*	(Press Site Pond)
D. K. Stone* and J. T. Valero*	(Static Test Road)
B. P. Kasper* (Field Crew Team Leader)	(East of SLC-34)
L. J. Ortega*	(East of SLC-34)
R. S. Precious, Secretary of STD	

Space Launch Operations
Systems Engineering Directorate
Environmental Systems
N. F. Dowling, Systems Director
H. L. Lundblad
Eastern Range
Systems Engineering Directorate
D. R. Schulthess

J. R. Ligda*	(Press Site Pond)
R. E. Reyes*	(East of UCS-4)
A. (Toni) Krell, Security	

2.3.2 Equipment

The equipment at each site included all the hardware and software necessary to record and document the launch, to communicate between sites, and to supply backup power in case of an outage at the fixed power distribution points. The VIRIS consists of an array of three full and one back-up (excluding the IR imager) cloud tracking systems and was designed and fabricated at the request of Space Launch Operations, Systems Engineering Directorate, at The Aerospace Corporation. Each full tracking system consists of coaligned visible (CCD) and infrared (IR = 8–12 μm) imagers, mounted on an azimuth- and elevation-encoding tripod, with an associated data acquisition and display console. The combination of visible and IR imagers permits cloud tracking in both daylight and darkness. The unique capabilities built into the VCR hardware include digital insertion of imager azimuth (AZ), elevation (EL), time, and GPS location. The system electronics is integrated in a single package, which has been ruggedized for field use. Pre-wiring of this package makes deployment of these imager systems straightforward, usually requiring less than 45 min for instrumentation at a site to become fully operational.

For the Titan IV A-17 mission, the operators at each site set the FOV of the visible imager using the adjustable 10 to 110 mm electronic zoom lens. They also selected the best lens for the IR imager. A fourth AGEMA IR imager was borrowed from another program to support this mission. All operators rotated the tripod head to keep the ground cloud within the FOV as it moved from the launch pad. Table 1 documents the FOV used by each imagery site for the A-17 mission.

Table 1. Field of View (FOV) for Imagery Sites during A-17 Mission

Imagery Site	Imager Type (Visible or IR)	FOV(horizontal) (degrees)	FOV(vertical) (degrees)
East of UCS-4	AGEMA Infrared	40.85	20.59
Pond at Press Site	AGEMA Infrared	41.45	19.88
Static Test Road	AGEMA Infrared	40.80	20.81
East of SLC-34	AGEMA Infrared	40.69	21.03

All four imaging systems deployed for the Titan IV A-17 mission were capable of total autonomy. Each VIRIS has an on-board differential-ready Xybion GPS receiver that can be used to document each imager's position with moderate spatial resolution. Typically, 35 m is the precision in the horizontal plane and 100 m is the precision in the vertical plane. For the A-17 imagery sites, a Trimble differential GPS provided more accurate GPS data (5 m resolution) for each of the surveyed camera sites. Gasoline-powered AC generators (Honda Ex1000) are insurance against loss or absence of facility power. The Stirling cooler option for the AGEMA 900 series IR imager was chosen so that liquid nitrogen would not be required at the sites. Each unit is transportable in a standard utility wagon (e.g., Ford Explorer).

The AZ/EL angle encoder for all imager systems was calibrated using reference objects (e.g., SLC-41) within the field of view of the imager. When reference objects are not part of the geodetic survey database, the GPS location uncertainty is the dominant term in their positional accuracy. Imager pixelation and operator error in edge detection contribute as well to the error in defining the cloud boundary. The 0.07° step-size in the tripod angle encoders is a third source of error. The analysis accuracy is determined either by the availability of optimal references for AZ/EL calibration or by the step size for the tripod angle encoder. Typically the VIRIS system provides 0.1° accuracy in both elevation and azimuth.

2.4 Processing of Imagery Data

The processing of the imagery data requires several transformations that are performed upon return to The Aerospace Corporation:

1. Digitizing frames of the visible imagery (i.e., daylight launches).
2. Measuring the pixel locations of the reference sites within each image (i.e., FOV and angular calibration).
3. Measuring the pixel locations of cloud features in digitized images.
4. Converting pixel locations to azimuth and elevation readings.
5. Calculating cloud characteristics (i.e., position in Cartesian coordinates relative to the launch pad).

The processing requires the use of specialized hardware and software. When used, visible images of the cloud are digitized at precise times, beginning with time intervals of 15 s, then 30 s, then 1 min as the cloud evolves. The AGEMA 900 IR imagers produce digital images every 15 s in the field. A set of digitized images is selected for specific times following the launch and from each of the available imagery sites. Time, AZ, and EL are tabulated for each set. A setup file is created for each of these sets, containing all relevant information necessary to compute the cloud geometry using the imagery. The Aerospace program's **PLMTRACK** and **PLMVOL** are run to digitize the x, y, and z coordinates of cloud features and to estimate the volume of the exhaust cloud, respectively. These programs report the x and y coordinates relative to the launch pad and the z coordinate as height above MSL. We converted the height MSL to height above ground level (AGL) by subtracting the 7 m MSL for the height of SLC-41. This allows direct comparison of the imagery-derived data to REEDM's output.

PLMTRACK is a software program developed and maintained in the Surveillance Technology Department (STD) of The Aerospace Corporation by Brian P. Kasper. It is designed to analyze pairs of cloud images synchronized in time. In various versions,[1] **PLMTRACK** has used the linear and rigorous (i.e., trigonometric) methods of interpreting pixels as AZ and EL and vice versa. **PLMTRACK** provides an absolute method of triangulating the position of the ground cloud without making any assumptions regarding the position of the ground cloud. This report presents the rigorous, trigonometric **PLMTRACK** results.

When using the **PLMTRACK Line Method**, the operator selects the location of a particular cloud feature in the images from the two imager sites by moving a screen pointer to the desired feature in each image and clicking a mouse button. **PLMTRACK** then calculates the point of nearest approach to the two rays defined by the selected points. The three-dimensional location of this feature is then written to a data file.

Another implementation of **PLMTRACK** is illustrated in Figure 1. When using the **PLMTRACK Box Method**, the operator draws a rectangle about the ground cloud in the images from the two sites

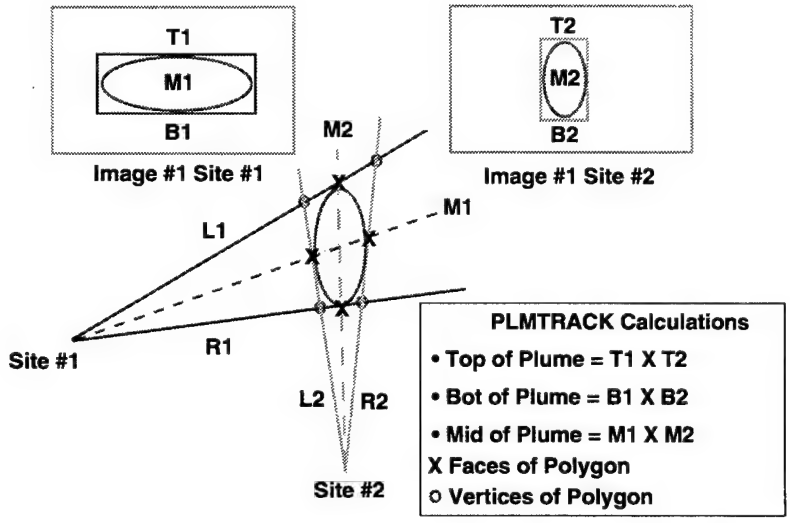

Figure 1. Implementation of the PLMTRACK "box" method with two imagers.

by moving a screen pointer to the extreme corners of the desired rectangles and clicking a mouse button. **PLMTRACK** then calculates the closest approach for various rays as illustrated in Figure 1 and described below. The top of the cloud is defined by rays determining T1 and T2 (i.e., T1 x T2); the bottom is determined by rays defining B1 and B2 (i.e., B1 x B2); and the middle is defined by the geometric mean of top and bottom (i.e., M1 x M2). To define the "faces" of the "box," the points of closest approach for ray M1 with L2 and R2 (the left and right tangents to the cloud from Imager 2) are defined (i.e., M1 x L2 and M1 x R2). A similar procedure is used to define the points of closest approach for M2 with L1 and R1, yielding M2 x R1 and M2 x L1. In addition to the centers of the faces of the "box," the intersects of the left and right rays document the four vertices for the XY polygon. Thus, eleven points are defined for the six-faced "box" surrounding the cloud (a point in the center of each of the six faces, four vertices for the XY polygon, plus a middle point for the "box"). These eleven sets of x, y, and z coordinates are written to a file.

When multiple imagery sites are viewing the cloud simultaneously, a multi-sided polygon method (documented in Figure 2) has been employed as a way to document the maximum extent of the cloud (i.e., a ground-plane projection) for all sets of images. With four imagers, there are redundant determinations of the top, middle, and bottom of the cloud by each pairing of imagery sites using **PLMTRACK**. The horizontal extent of the cloud is determined by defining the rays from each imager that are tangential to the widest part of the cloud as seen from that site. Projection of these

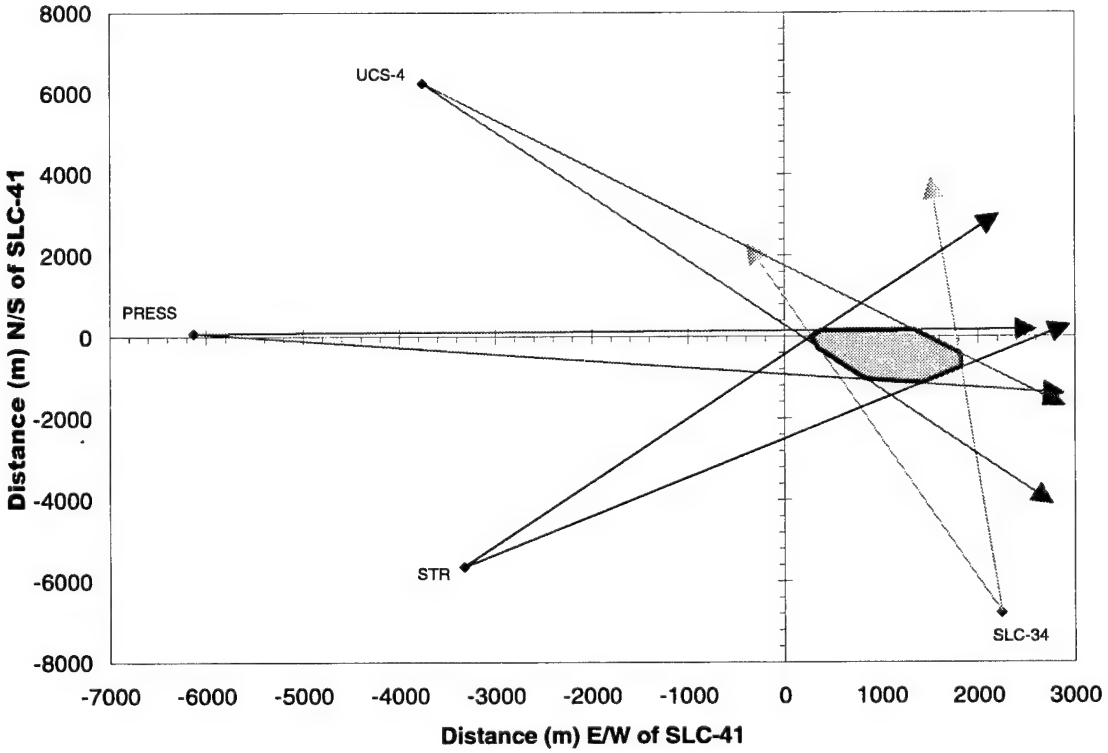

Figure 2. Comparison of the A-17 cloud extent derived from the polygon analysis and from the PLMVOL analysis (i.e., shaded area within the polygon). The imager positions and rays are actual A-17 data for T+02:15 (mm:ss) after launch.

extreme rays for each imager on the x-y ground plane forms a polygon that bounds all material in the cloud at all altitudes, as shown in Figure 2. Thus, when an aircraft is flown against the ground cloud (i.e., K-15,[2] K-16,[3] K-22,[4] and K-23,[5] missions), one expects to see aircraft HCl sampling "hits" fall within this polygon, regardless of the sampling altitude. When the polygon area is combined with the mean cloud height (i.e., the difference between the top and the bottom of the cloud), one can obtain an upper bound for cloud volume. As illustrated in Figure 2 (a ground projection of the cloud's extent), the shaded area within the polygon documents the extent of the cloud derived from **PLMVOL** analysis. There is excellent agreement between **PLMTRACK** and **PLMVOL** results.

The utility of the polygon method has been documented in previous reports for the K-152 and K-235 missions. In those reports, the polygons from imagery were correlated with aircraft's HCl measurements of cloud dimensions and average HCl concentrations for the Titan IV launch cloud. After correcting for Geomet time response, these datasets established that HCl concentrations detectable by an aircraft-based Geomet total HCl detector were mostly contained by the six-sided polygon areas for the first 10 to 20 min after launch. The K-15 and K-23 data established that the imagery-derived position and extent of the visible cloud correlates with the measurable HCl concentrations. A similar treatment is possible with the A-17 imagery (without aircraft data) and allows a mapping of the growth and position of the cloud over time.

Brian P. Kasper also created and maintains the **PLMVOL** program at The Aerospace Corporation. **PLMVOL** provides a convenient way of triangulating all of the volume elements that could be occupied by an object using imagery from two (or more) sites. Like **PLMTRACK**, **PLMVOL** uses a rigorous (i.e., trigonometric) method[1] of interpreting pixels as AZ and EL and vice versa. For the A-17 mission, the **PLMVOL** algorithm provided an absolute method of triangulating the position and volume of the ground cloud. The analyst outlined the edge of the ground cloud in simultaneously acquired images from the four sites. **PLMVOL** determined all of the pixels that were within the outlines in each image and projected the rays for all of those pixels into space. **PLMVOL** defined volume elements in space and determined which volume elements were intercepted by the projected rays from all imagery sites. These intersected volume elements could be occupied by the ground cloud. **PLMVOL** reports the x,y,z coordinates for all "occupied" volume elements. The coordinates are relative to a reference (i.e., SLC-41 for x and y and mean sea level for z). **PLMVOL** calculates the total volume (i.e., sum of all occupied volume elements), the sphere-equivalent radius, and the mean altitude for the ground cloud (i.e., mean position of all occupied volume elements). For facile comparison to REEDM, this report uses altitude relative to SLC-41 pad (i.e., AGL) rather than MSL in all plots.

The **PLMVOL** approach is illustrated by Figure 3 for simultaneous images of the Titan IV K-23 normal launch cloud from three sites. We used the K-23 images to illustrate **PLMVOL** since that cloud had a complicated shape, and the imagery was not folded. The **PLMVOL**-derived reconstructed cloud is shown from a perspective similar to the middle image in Figure 3, but can be viewed from any perspective.

PLMVOL analysis of the A-17 imagery was possible between 0.25 and 9.50 min after the launch. In addition to the ground track, the rise rate, the stabilization height, and the extent that could also be derived from **PLMTRACK** analysis, **PLMVOL** provided volumetric data and altitude-dependent extent.

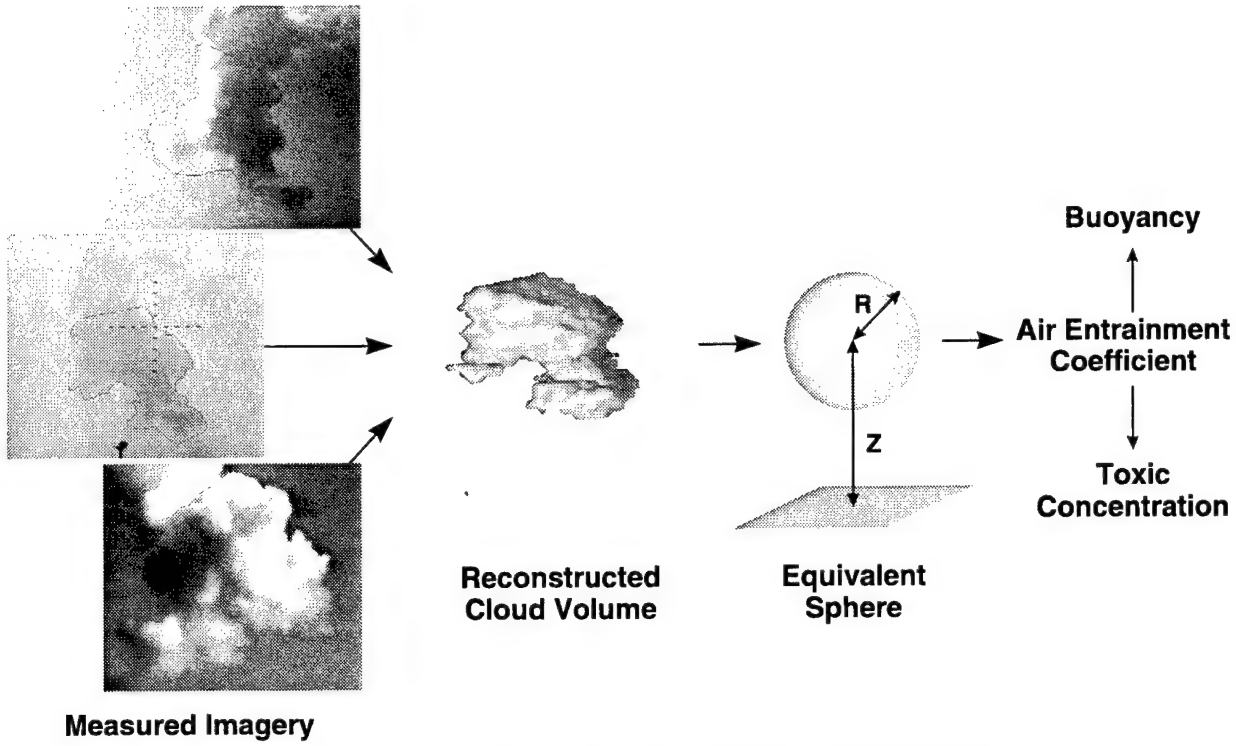

Figure 3. PLMVOL approach illustrated by Titan IV K-23 ground cloud images.

2.5 Results and Discussion

2.5.1. Correlation of Ground Cloud Bearing with Wind Direction

Figure 4 presents the imagery-derived cloud bearing and the T-0.6 h REEDM version 7.08 predicted ground cloud bearings as arrows originating from the launch pad and as text. The darkly bordered two REEDM 7.08 predictions (i.e., default and tuned runs that use 0 m as the initial cloud height). Figure 4 also documents the rawinsonde wind directions at the imagery-derived heights for the top, middle, and bottom of the stabilized ground cloud. The rawinsonde wind bearings are illustrated with narrow arrows originating from the rawinsonde release site and in a narrowly bordered text box. Lastly, Figure 4 documents the locations of SLC-41 launch pad, the rawinsonde release site, and the four imager sites (UCS-4, Press, STR, and SLC-34) used by The Aerospace Corporation for the A-17 mission. All directions are reported in rawinsonde convention [defined fully in Subsection 2.5.4]. Briefly, the arrows indicate the direction the cloud would move for a wind coming from the reported angle (clockwise from north).

As illustrated in Figure 4, there is reasonably good agreement between the imagery-derived cloud bearing, the REEDM version 7.08 predicted cloud bearing, and the rawinsonde wind directions at the equivalent heights. The quantitative imagery documented a cloud bearing of 293° by **PLMVOL** analysis (i.e., wide arrow in Figure 4) during the first 9.50 minutes after launch. REEDM version 7.08 predicted a shift in cloud bearing during rise: 281° at 13.0 m altitude to 299° at 893 m AGL. REEDM version 7.08 predicted the cloud's bearing as 299° (i.e., medium arrow in Figure 4) to the maximum cloud concentration at the predicted stabilization height (i.e., 947 m AGL). This is almost identical to the predicted cloud bearing of 298° to the maximum cloud concentration at ground level.

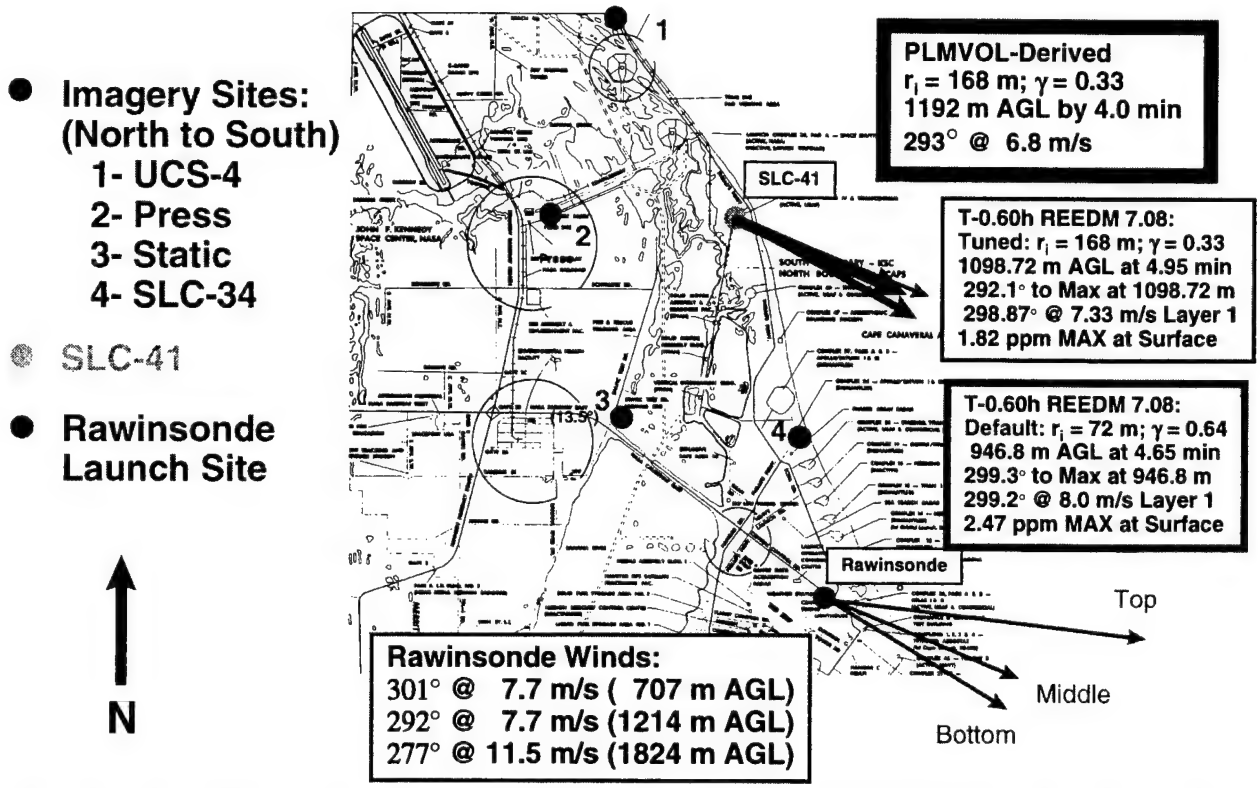

Figure 4. A map documenting the imagery sites, the rawinsonde release site, the A-17 ground cloud's bearing (derived from infrared imagery), the T-0.6 h REEDM Version 7.08 predictions for the ground cloud's bearing (at stabilization height), and the 01:32 GMT (T-0.6 h) rawinsonde wind directions at the imagery-derived cloud stabilization heights (i.e., bottom, middle and top of the ground cloud).

After stabilization, REEDM predicts a 299° cloud bearing at 947 m AGL (based upon the average wind in the first mixing layer). At ground level, the cloud's predicted bearing was 298° after stabilization. There are negligible differences in the predicted bearings at the stabilization height and at ground level due to almost negligible wind shear between the stabilization height and the ground. This is consistent with the imagery and with the T-0.6 h rawinsonde data. Figure 4 also presents the rawinsonde-derived wind directions (301°, 292°, and 277°) associated with the rawinsonde sounding heights (707, 1214, and 1824 m AGL) nearest the bottom, middle, and top of the stabilized ground cloud, respectively. These wind directions are from the T-0.6 h rawinsonde data and at the indicated sounding heights, which are closest to imagery-derived stabilization heights of 781, 1192, and 1775 m AGL for the bottom, middle, and top of the ground cloud, respectively.

Figures 5 through 9 document background-subtracted IR images for T+0.25 min, T+1.25 min, T+2.25 min, T+6.00 min, and T+7.00 min as recorded from (clockwise) UCS-4, Press, SLC-34, and STR sites. These images have the intensity "folded" to only 6 bits and include PLMVOL outlines and reflections. The outlines document the extent of the ground cloud in each perspective. The reflections are the centers of the intercepted volume elements reflected back into the image. For a perfect calibration, the reflections would be scattered throughout the outline. If the calibration were bad, **PLMVOL**'s "reflected" rays would not fill a portion of the cloud outline. Therefore, these images document a good calibration of the imagery.

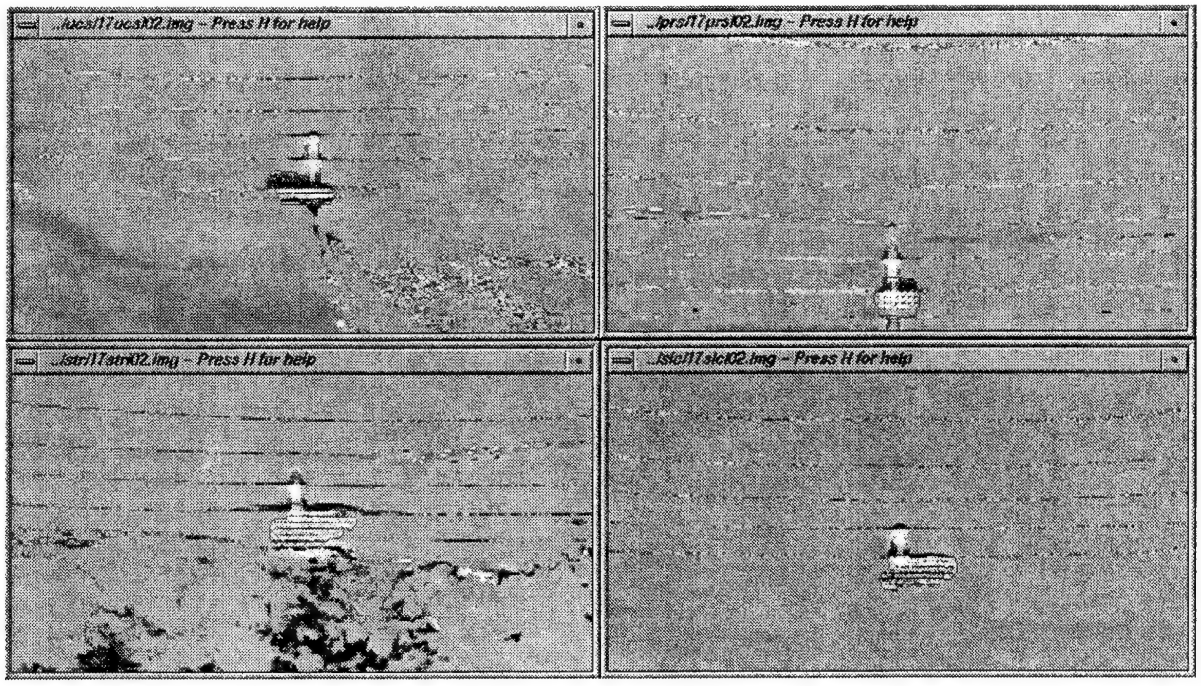

Figure 5. PLMVOL Reflection in T+0.25 min imagery from UCS-4, Press, STR, and SLC-34.

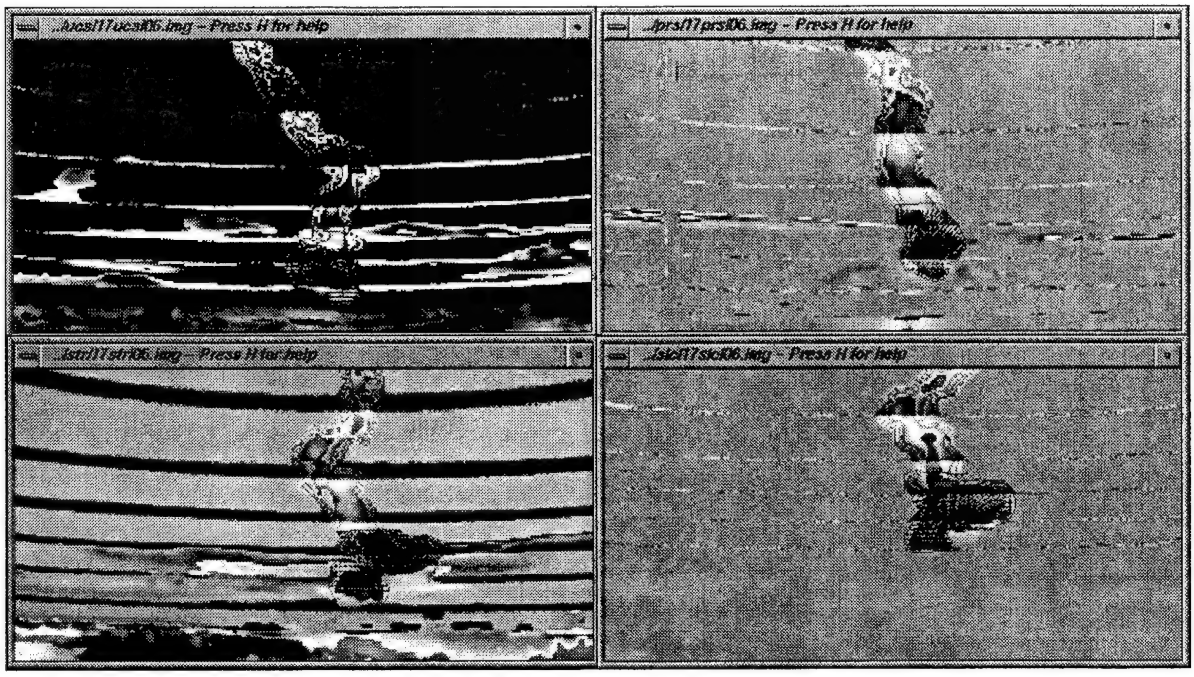

Figure 6. PLMVOL Reflection in T+1.25 min imagery from UCS-4, Press, STR, and SLC-34.

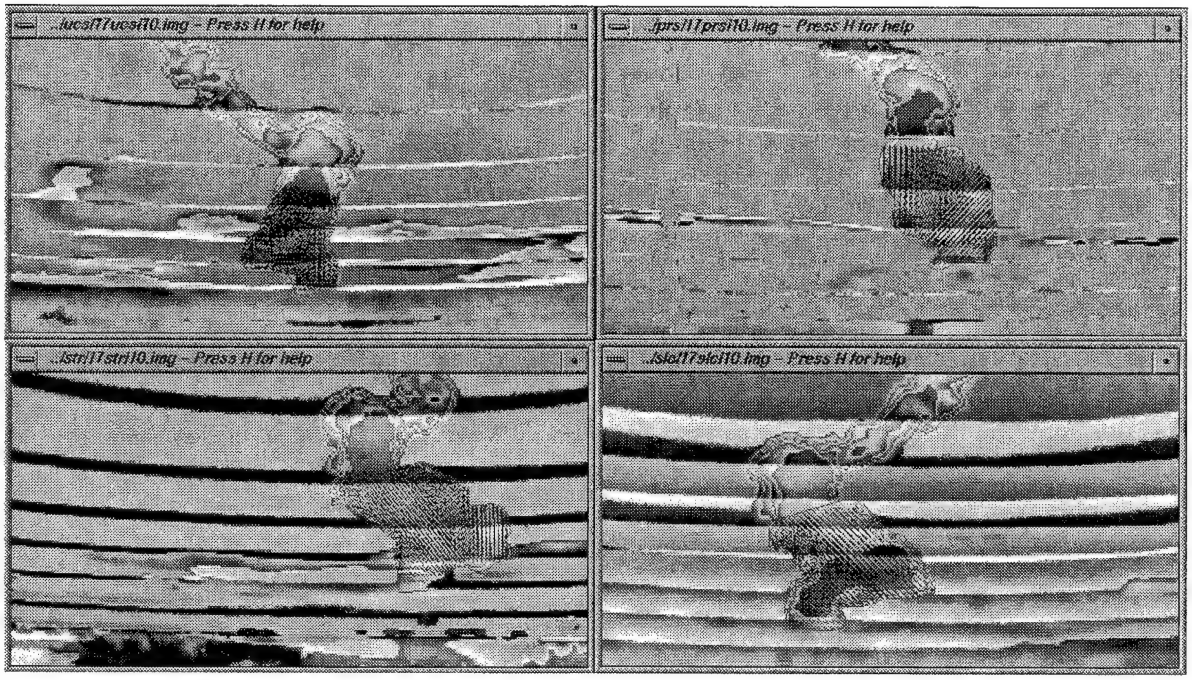

Figure 7. PLMVOL Reflection in T+2.25 min Imagery from UCS-4, Press, STR, and SLC-34.

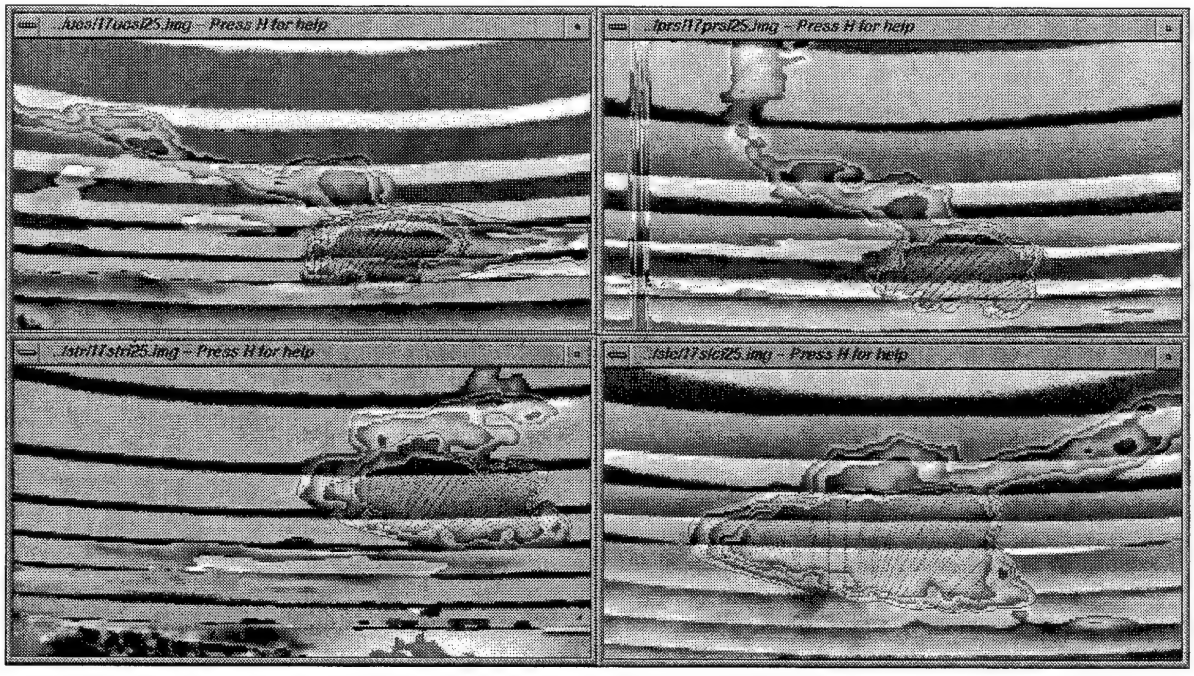

Figure 8. PLMVOL Reflection in T+6.00 imagery from UCS-4, Press, STR, and SLC-34.

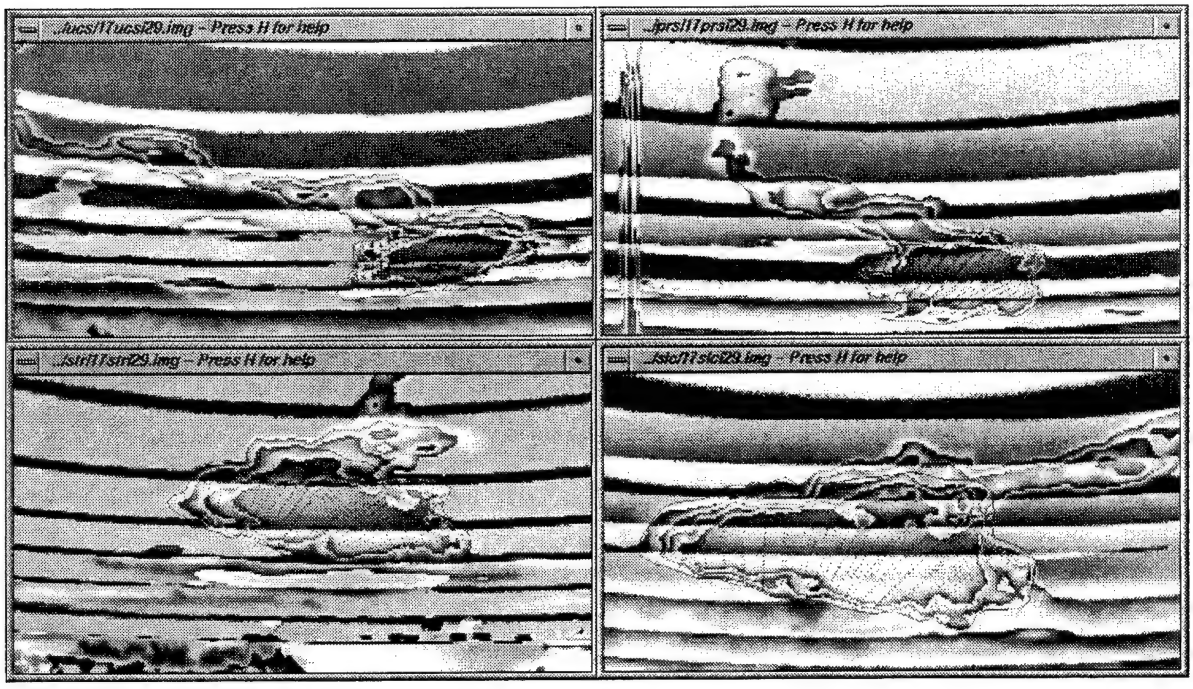

Figure 9. PLMVOL Reflection in T+7.00 min imagery from UCS-4, Press, STR, and SLC-34.

In Figure 5, the northwestern (USC-4) and southern (SLC-34) perspectives document asymmetry in the cloud's initial shape with a lobe to the east (i.e., left from UCS-4 and right from SLC-34 perspectives). This outcropping of exhaust resulted from ejection of exhaust to the east from the exhaust duct on SLC-41 pad. For Press and STR sites, there is a reflection of the ground cloud observable in the water between the sites and SLC-41. Narrow intensity bands document folding of the intensity at various elevations and about the launch cloud. The analyst drew the outlines after reviewing all available imagery and included only the portion of the cloud believed to be the ground cloud and launch column consumed by the rising ground cloud.

2.5.2. Cloud Rise Times and Stabilization Heights

Figures 10 through 12 present the imagery-derived, time-dependent altitude for the "bottom," the "middle," and the "top" of the ground cloud based upon **PLMVOL** analysis. In these plots, all data are plotted as height in meters above SLC-41 (i.e., m Above Ground Level). The analyst used **PLMVOL** to process imagery from all four sites simultaneously. Therefore, the plots in Figures 10 through 12 report only one result for each set of images. These data document the stabilization height for the bottom, the center, and the top of the ground cloud.

A polynomial fit is used when the cloud is tracked through stabilization. A polynomial fit is a convenient method to permit the representation of cloud overshoot and subsequent damped oscillation around the stabilization height. To be consistent with REEDM, stabilization time and height refer to the first maximum in polynomial fits. REEDM predicts that the cloud goes through damped oscillatory motion with a period of $2\pi/S^{1/2}$, where S is the static stability parameter [Ref. 6, Eq. (7)][6]. Sensitivity of REEDM predictions to input parameters has been examined by Womack.[7]

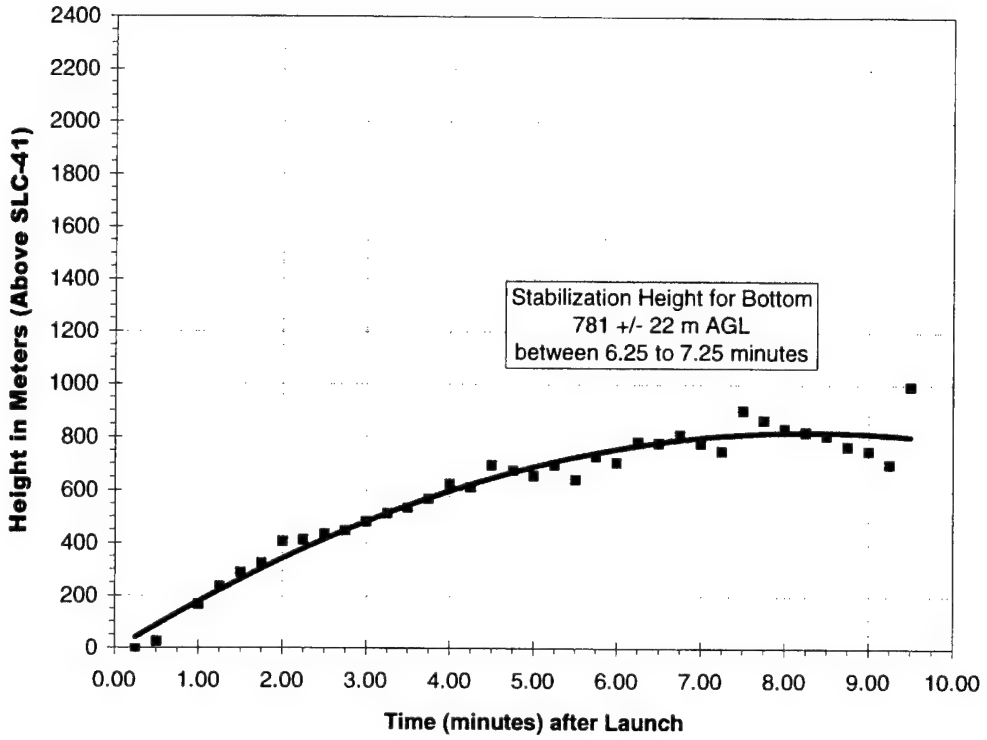

Figure 10. Cloud rise for the bottom of the A-17 cloud (PLMVOL analysis).

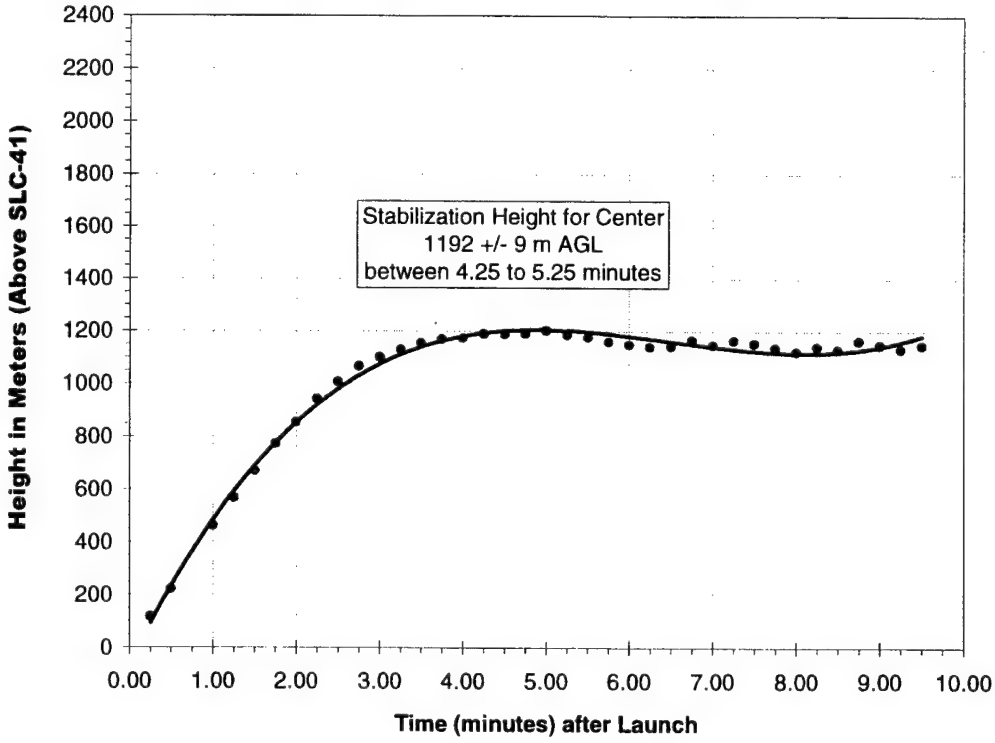

Figure 11. Cloud rise for the middle of the A-17 cloud (PLMVOL analysis).

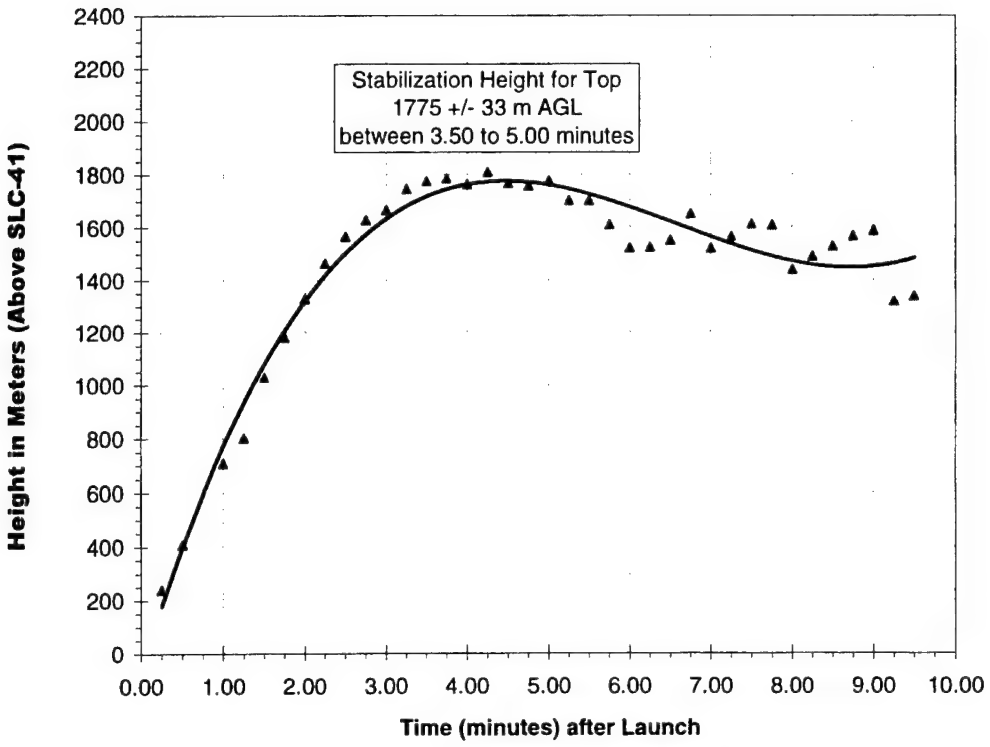

Figure 12. Cloud rise for the top of the A-17 cloud (PLMVOL analysis).

2.5.3. Comparison of REEDM Prediction to Imagery Data—Rise Rate

Figure 13 presents the **PLMVOL**-derived heights for the ground cloud's top, middle, and bottom plotted as a function of time following the launch. For comparison, Figure 13 includes the predicted curves for the middle of the cloud based upon two T-0.6 h REEDM modeling runs. It is apparent that the "tuned" REEDM run more closely models the imagery-derived rise curve than the "default" REEDM run. The "tuned" run uses the imagery-derived values of 168 m for the initial radius, 0 m for the initial height, and 0.33 for the entrainment coefficient. The "default" REEDM run uses the default values of 72 m for the initial radius, 0 m for the initial height, and 0.64 for the entrainment coefficient. In both cases, one would obtain a higher value for the stabilization height by setting the initial height equal to the initial radius (i.e., 72 m for the default run and 168 m for the tuned run). This would raise the stabilization height accordingly and, therefore, provide an even better fit to the observed rise curve for the center of the ground cloud.

2.5.4. Comparison of REEDM Prediction to Imagery Data—Bearing and Speed

Figures 14 and 15 document the imagery-derived cloud bearing and speed, respectively. These figures document the results derived from **PLMVOL** analysis. The **PLMVOL** "center" is a weighted average based upon the locations of all intersected (i.e., "occupied") volume elements reported by **PLMVOL**.

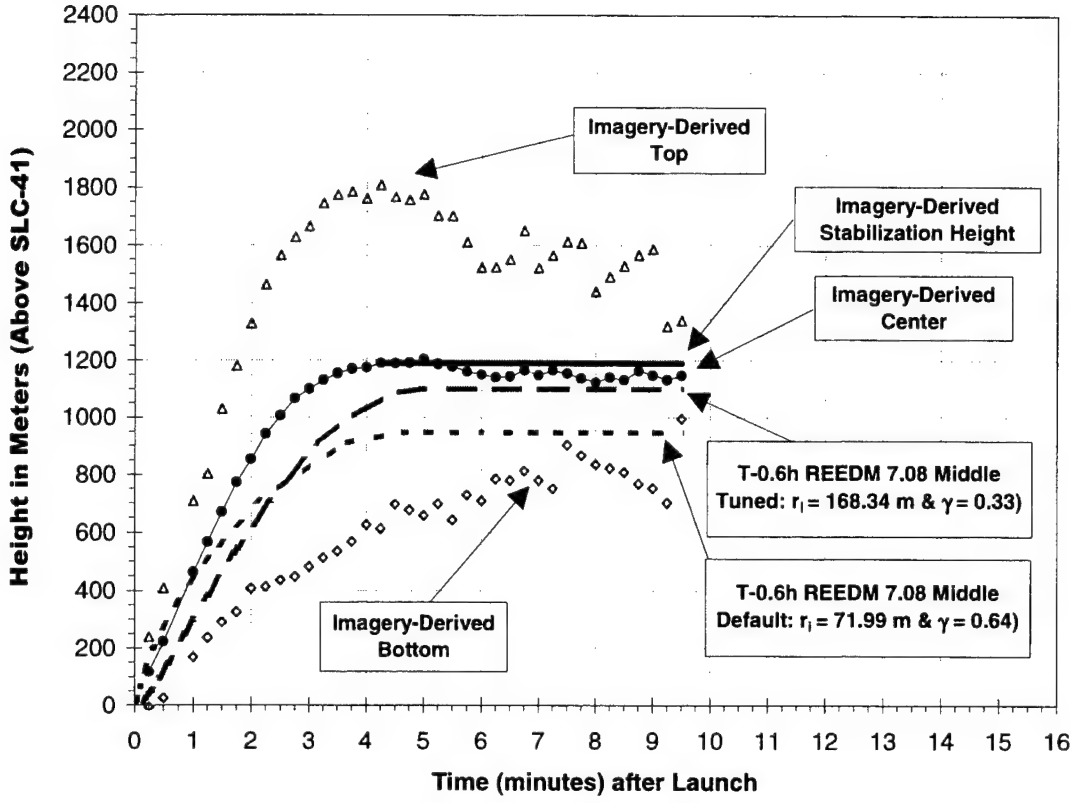

Figure 13. Predicted versus measured rise curves (PLMVOL analysis).

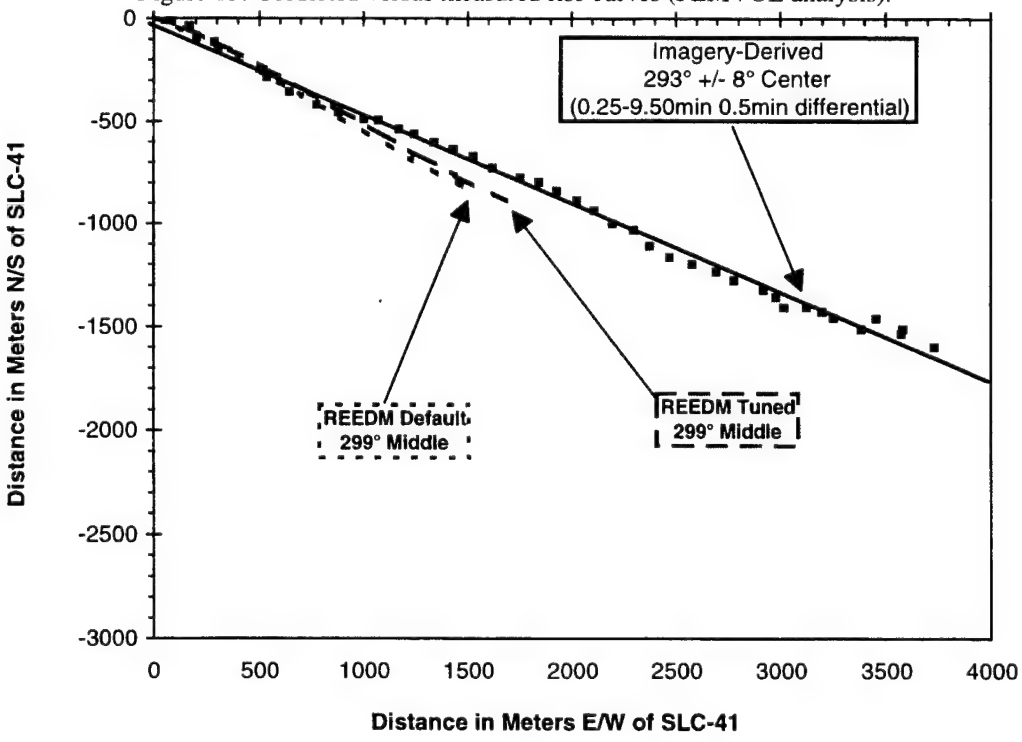

Figure 14. Predicted and measured bearings (PLMVOL analysis).

In this report, the angles conform to the convention of rawinsonde wind vectors (the angle from which the wind originates that would push the cloud into its imaged position). Thus, the angles are related by

$$J = 180 + F,$$

where ϑ is the equivalent rawinsonde wind angle and Φ is the measured polar angle of the cloud relative to SLC-41 and clockwise of true north. For example, when the cloud is due east of SLC-41, Φ is 90° and ϑ is 270°.

Figure 14 plots the Cartesian coordinates for the ground cloud between 0.25 and 9.50 min after launch. The **PLMVOL** results are for the center of the cloud and document a bearing of 293°. **PLMVOL** analysis uses a detailed outline about the ground cloud and uses imagery from all available sites simultaneously. The text box provides the average (293°) and standard deviation (8°) for a moving 0.5-min differential speed between PLMVOL data points (i.e., x,y data). For comparison, Figure 14 includes the predictions for both the "tuned" and "default" REEDM version 7.08 runs. The predictions stop at stabilization while the PLMVOL data continues past stabilization. It is apparent that there is reasonably good agreement between the predicted and measured bearings.

Figure 15 is a distance versus time plot and documents the PLMVOL-derived cloud speed as well as REEDM version 7.08 "tuned" and "default" predictions. The text box also documents the 1-min differential speed for the ground cloud during the 9.50 min of available imagery. The differential treatment documents an average (6.8 m/s) and a standard deviation (1.0 m/s) for the cloud's center speed. It is apparent that there is reasonably good agreement between the predicted and measured speeds.

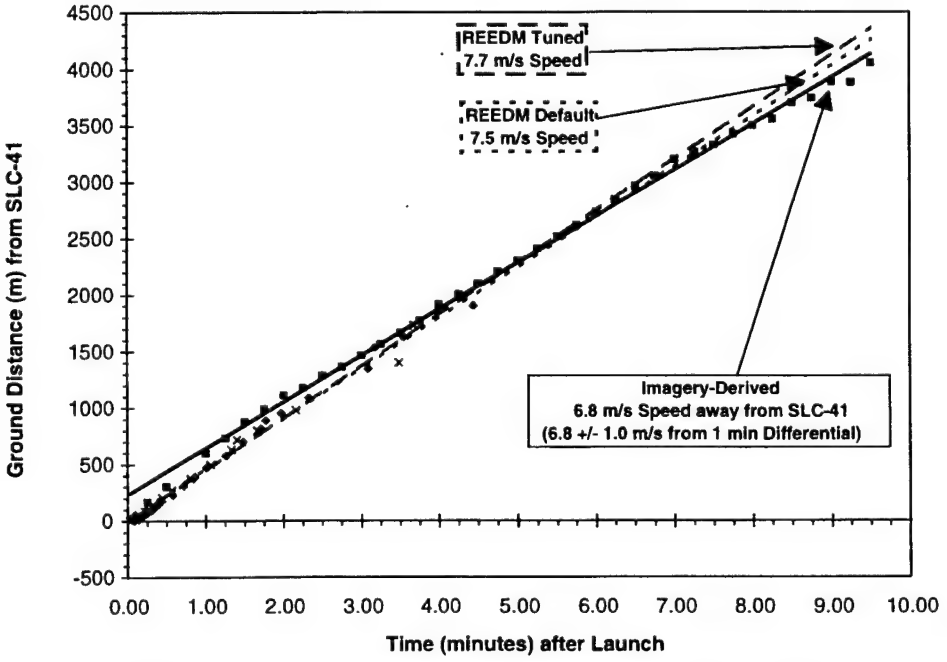

Figure 15. Predicted and measured cloud speed (PLMVOL analysis).

Figure 16 documents **PLMVOL** results as an increase in cloud volume with time. Figure 17 conveys the same **PLMVOL** results as an increase in the cloud's sphere-equivalent radius (SER) with altitude. The SER is the radius of a sphere that has the same volume as measured by **PLMVOL**. The initial slope of a fit to SER plotted against altitude is, by definition, the entrainment coefficient used by REEDM. Therefore, Figure 17 documents a measured entrainment coefficient of 0.33 with 0.974 R^2 during the first 2.0 min of rise (i.e., 0.31 for first 1.75 min with 0.975 R^2 and 0.36 for first 2.25 min with 0.966 R^2). These values are comparable to the imagery-derived entrainment coefficients[1] for the 34D-9 abort cloud (i.e., 0.35), for three Titan IVA launches (i.e., 0.35 for K23, 0.37 for K19, and 0.39 for A18), and for two Titan IVB launch (i.e., 0.35 for B24 and 0.39 for B33). The average of all of the imagery-derived values (0.36 with a standard deviation of only 0.02) is substantially smaller than REEDM's default value of 0.64. Likewise, the average value for the initial radius (i.e., 179 m with a standard deviation of 20 m) is substantially larger than REEDM's default value of 72m.

2.5.5. Comparison of REEDM Prediction to Imagery Data -- Summary Table

Table 2 summarizes the imagery derived, the T-0.6 h rawinsonde measured, and the T-0.6 h REEDM predicted data for the A-17 ground cloud. Several conclusions can be derived from review of the contents of this table and from the discussions in previous sections of this chapter:

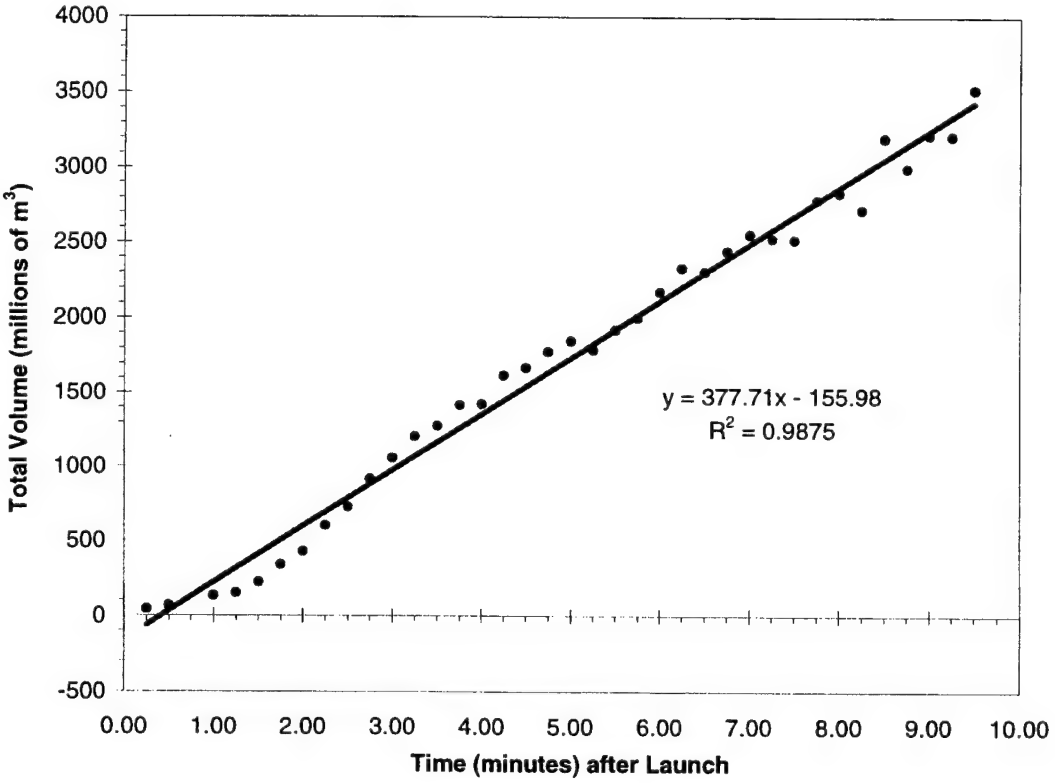

Figure 16. Cloud volume versus time (PLMVOL analysis).

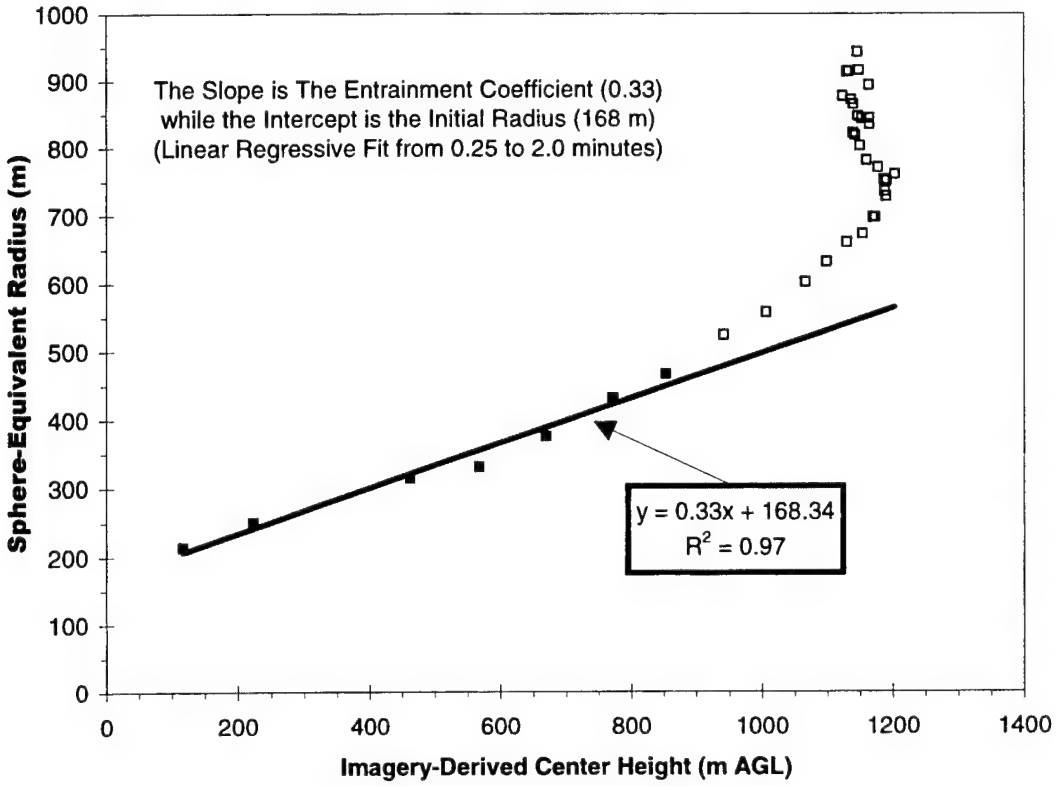

Figure 17. Sphere-equivalent radius versus altitude (PLMVOL analysis).

- The imagery-derived stabilization height (1192 m AGL) is 26% higher than the "default" REEDM prediction (947 m AGL) and only 8% higher than the "tuned" REEDM prediction (1099 m AGL);

- The imagery-derived bearing (293°±8°) and speed (6.8±1.0 m/s) are in fair agreement with the T-0.6 h rawinsonde winds (292° and 7.7 m/s), with the T-0.6 h REEDM Version 7.08 "default" predictions (299° and 7.5 m/s) and with the T-0.6 h REEDM Version 7.08 "tuned" predictions (292° and 7.7 m/s);

- The imagery-derived entrainment coefficient (0.33) is 39% smaller than REEDM's default value (0.64);

- The imagery-derived extrapolated initial cloud radius (168 m) is 133% larger than REEDM's default value (72m); and

- The predicted ground concentration drops from 2.5 ppm for the "default" REEDM run to 1.8 ppm for the "tuned" REEDM run.

Table 2. Summary of A-17 Ground Cloud Data Derived from Infrared Imagery, T-0.6h Rawinsonde Sounding Data, & T-0.6h REEDM Version 7.08 Predictions.

Attribute	Feature	Imagery (IR only)	Rawinsonde (T – 0.60 h)	REEDM 7.08 (Default)	REEDM 7.08 (Tuned)
Stabilization Height	Top	1775		1671	1519
Meters Above SLC-41	Middle	1192		947	1099
(SLC-41 = 7 m MSL)	Bottom	781		300	707
Stabilization Time	Top	3.50			
Minutes After Launch	Middle	4.25		4.65	4.95
	Bottom	6.25			
Bearing (deg)	Top	297	277		
(rawinsonde)	Middle	293	292	299	299
at Specified Levels	Bottom	293	301		
Bearing (deg)	After Stab.	293		299	299
(rawinsonde)	To Max.	293		299	292
During Time Interval	During Rise	293		281–299	281–299
Speed (m/s)	Top	7.7±3.3	11.5		
(along trajectory)	Middle	6.8±1.0	7.7	8.0	7.3
at Specified Levels	Bottom	8.7±2.1	7.7		
Speed (m/s)	After Stab.	6.8±1.0		8.0	7.3
(along trajectory)	To Max.	6.8±1.0			
During Time Interval	During Rise	6.8±1.0		7.5	7.7
Entrainment Coeff.	During Rise			0.64	0.33
Initial Radius (m)	At Height = 0	168		72	168
Initial Height (m)	At t = 0	0		0	0
Rise Rate (time)	During Rise	Linear		2nd Order	Linear
Max Ground HCl (ppm)	Surface			2.5	1.8

We ran REEDM Version 7.08 in the research mode using the imagery-derived initial radius (168 m), an initial height equal to 0 m (the REEDM default), and the imagery-derived entrainment coefficient (0.33). This "tuned" research run was a better fit to the imagery-derived data. The predicted stabilization heights for the bottom, middle, and top of the cloud jumped from 299, 947, and 1672 m (i.e., the results of the normal run using the REEDM "default" settings) to 707, 1099, and 1519 m for the "tuned" research run. The predicted vertical extent of the cloud decreased by 41% while the predicted stabilization height increased by 16% by changing these two REEDM parameters. These differences shift the predicted ground-level HCl concentrations from 2.5 ppm for the "default" run to 1.8 ppm for the "tuned" run. Fortunately, there is imagery data for the vertical extent (994 m) of the cloud and its stabilization height (1192 m AGL) for the A-17 mission. The "tuned" run predicts a more accurate extent (i.e., 812 m is only 18 % smaller than the imagery-derived extent) and a more accurate stabilization height (i.e., 1099 m is only 8% lower than the imagery-derived stabilization height). In contrast, the default run's predictions were too big for the vertical extent (1373 m is 38% larger than the imagery-derived extent) and too low for the stabilization height (i.e., 947 m AGL is 21% lower than the imagery-derived stabilization height). One obtains proportionately higher stabi-

2.6 Summary and Conclusions

The Titan IV A-17 mission was launched successfully from the Eastern Range (SLC-41) at 2105 EST (0205 GMT) on 7 November 1997. Personnel from The Aerospace Corporation imaged the ground cloud for 9.50 min after the launch from four camera sites. When combined with the AZ/EL readings and the IRIG-B time data, the quantitative imagery documented the rise, stabilization, growth, speed, and bearing of the ground cloud. This quantitative imagery data for the A-17 ground cloud will be useful for tuning current and future dispersion models.

The definition of the A-17 exhaust cloud's geometric features was complicated by its three-dimensional shape (i.e., not spherical). However, the imagery successfully documented this complex shape as the cloud evolved (i.e., asymmetric ejection from the exhaust duct, rapid rise of the hot ground cloud, and continued dispersion after reaching its stabilization height).

Analysis of the imagery data presented in this report has focused on determining parameters that are directly comparable to REEDM predictions. The imagery-derived cloud bearing and speed were similar to T-0.6h rawinsonde winds and to T-0.6h REEDM version 7.08 predictions. However, the imagery documented several differences between the ground cloud and REEDM predictions:

- The imagery-derived stabilization height (1192 m AGL) is 26% higher than the "default" REEDM prediction (947 m AGL) and only 8% higher than the "tuned" REEDM prediction (1099 m AGL);

- The imagery-derived bearing (293°±8°) and speed (6.8±1.0 m/s) are in fair agreement with the T-0.6 h rawinsonde winds (292° and 7.7 m/s), with the T-0.6 h REEDM Version 7.08 "default" predictions (299° and 7.5 m/s) and with the T-0.6 h REEDM Version 7.08 "tuned" predictions (292° and 7.7 m/s);

- The imagery-derived entrainment coefficient (0.33) is 39% smaller than REEDM's default value (0.64);

- The imagery-derived extrapolated initial cloud radius (168 m) is 133% larger than REEDM's default value (72m); and

- The predicted ground concentration drops from 2.5 ppm for the "default" REEDM run to 1.8 ppm for the "tuned" REEDM run.

The Aerospace Corporation has imaged 14 Titan IVA and 2 Titan IVB launches as part of the Model Validation Program. The available imagery documents that the default REEDM runs often underestimate the stabilization height of the ground cloud. Such overly conservative REEDM predictions can result in unnecessary launch holds at a considerable cost to the Air Force. The available imagery documents a larger initial radius and a smaller entrainment coefficient than the current default values used by REEDM version 7.08. Titan IV A and B exhaust cloud data are needed to validate and to tune current and future dispersion models for both ranges (Vandenberg AFB and CCAS) and for the various meteorological conditions associated with round-the-clock and year-round launch schedules.

References

1. R. N. Abernathy, "Titan 34D-9 Abort Cloud Measurements — Quantitative Imagery from Two Camera Sites," The Aerospace Corporation Technical Report TR-98(1410)-1, The Aerospace Corporation, El Segundo, CA (20 February 1998).

2. R. N. Abernathy and K. L. Foster, "Ground Cloud Dispersion Measurements During The Titan IV Mission #K15 (5 December 1995) at Vandenberg Air Force Base – Volume 2 – Further Analysis of Quantitative Imagery and of Aircraft HCl Data," The Aerospace Corporation Technical Report TR-98(1410)-2, 12 May 1998.

3. R. N. Abernathy, B. P. Kasper, J. Y. Webb, and K. L. Foster, "Imagery of the Titan IV #K16 Ground Cloud," Chapter 2 and R. N. Abernathy and K. L. Foster, "Aircraft Elevated HCl Measurements," Chapter 3 in The Aerospace Corporation Report No. TR-97(1410)-4 and SMC-TR-97-10, "Ground Cloud Dispersion Measurements During the Titan IV #K16 (24 April 1996) at Cape Canaveral Air Station, Volume 1 – Test Overview and Data Summary," 31 March 1997.

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6. J. R. Bjorklund, "User's Manual for the REEDM Version 7 (Rocket Exhaust Effluent Diffusion Model) Computer Program," Vol. I, TR-90-157-01, AF Systems Command, Patrick AFB, FL (April 1990).

7. J. M. Womack, "Rocket Exhaust Effluent Diffusion Model Sensitivity Study," TOR-95(5448)-3, The Aerospace Corporation, El Segundo, CA (May 1995).

Appendix A—REEDM Version 7.08 Predictions for the A-17 Mission

[The material in this section was contributed by R. N. Abernathy of the Surveillance Technology Department of The Aerospace Corporation's Space and Environment Technology Center]

This Appendix includes REEDM version 7.08 runs for impact at both the surface (0 m AGL, 7 m MSL) and stabilization height (predicted by REEDM). We include the plots of the rawinsonde meteorological data, the predicted maximum concentration versus downwind distance, and the predicted concentration isopleths overlayed on a range map. These plots are followed by the detailed REEDM report for that run.

Stabilization Height Predictions

The following figures and table are the REEDM version 7.08 output for the stabilization height run. These predictions were compared with actual A-17 ground cloud observations in Section 2 for the quantitative imagery. The first page of the REEDM output is its listing of errors and is not included in this appendix.

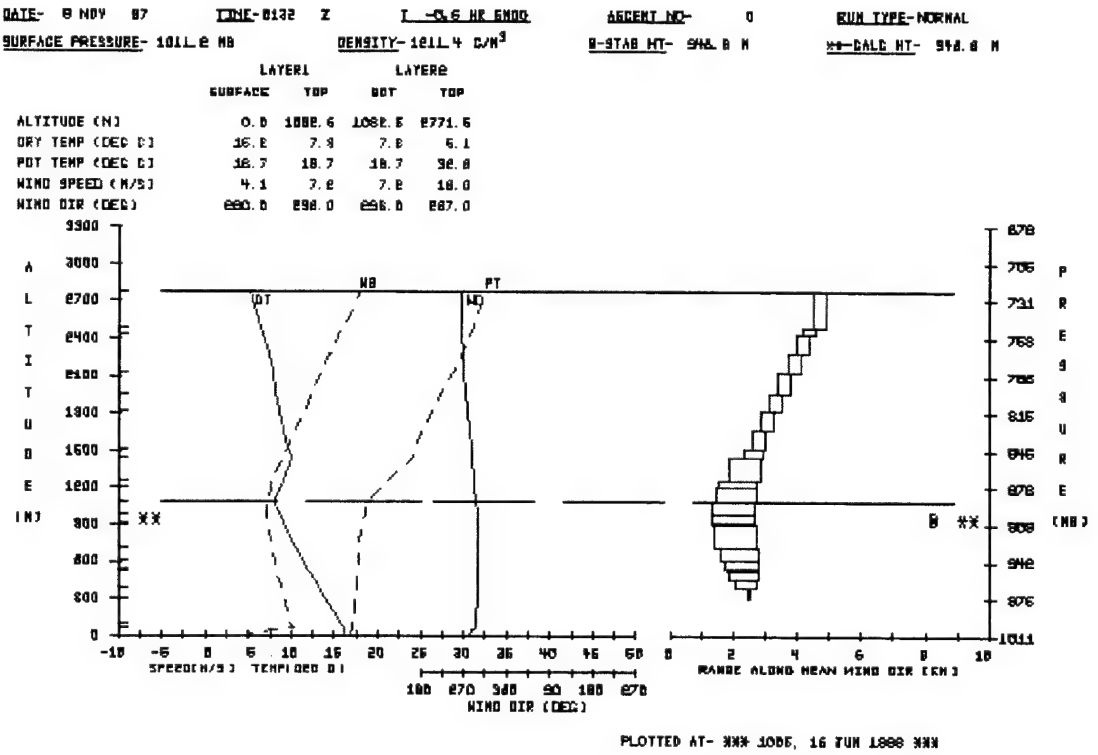

Figure 1A. Meteorological Output Plot from REEDM Version 7.08 for A-17 Mission Using T-0.6h Rawinsonde Data.

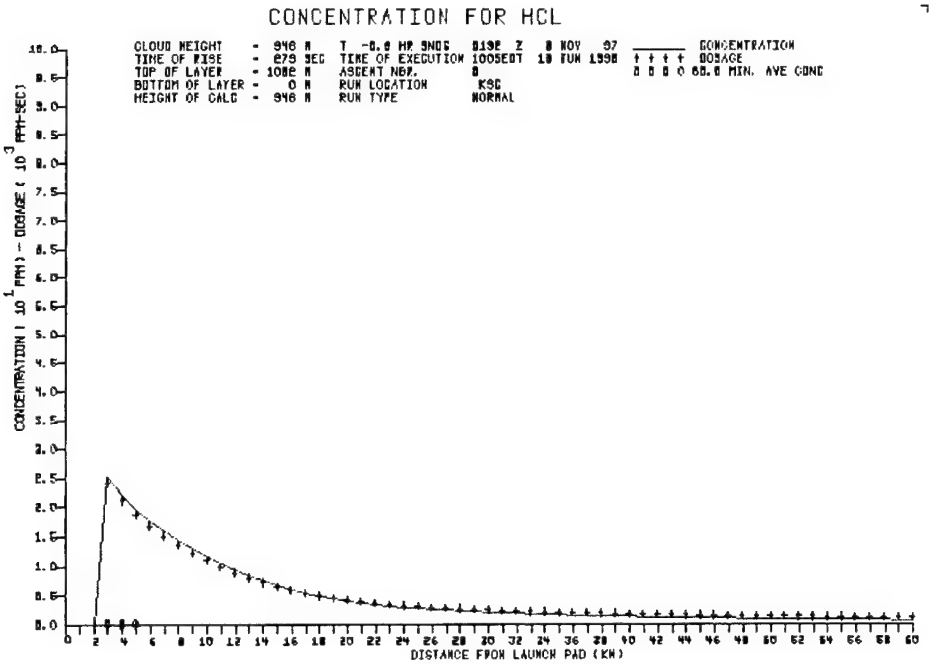

Figure 2A. HCl Stabilization Height Concentration Predictions from REEDM Version 7.08 for A-17 Mission Using T-0.6h Rawinsonde Data.

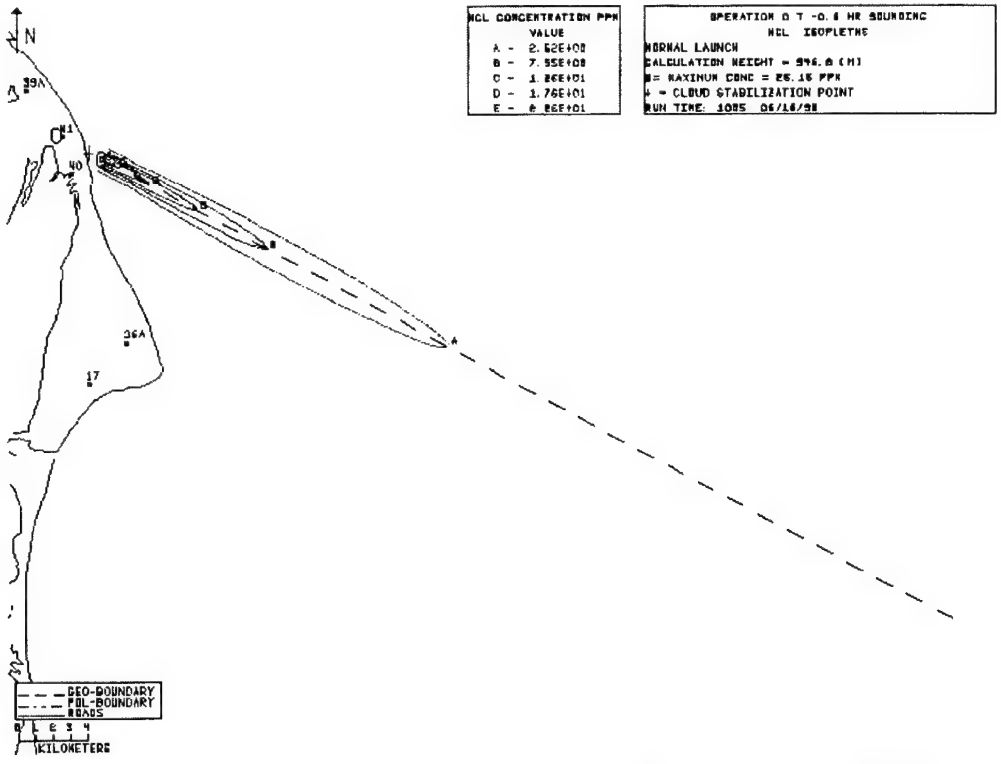

Figure 3A. HCl Stabilization Height Concentration Isopleth Predictions from REEDM Version 7.08 for A-17 Mission Using T-0.6h Rawinsonde Data.

1**********

ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 2
VERSION 7.08 AT KSC
1005 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- PROGRAM OPTIONS -----

MODEL		CONCENTRATION
RUN TYPE		OPERATIONAL
WIND-FIELD TERRAIN EFFECTS MODEL		NONE
LAUNCH VEHICLE		TITAN IV
LAUNCH TYPE		NORMAL
LAUNCH COMPLEX NUMBER		41
TURBULENCE PARAMETERS ARE DETERMINED FROM		CLIMATOLOGICAL DATA
SURFACE CHEMISTRY MODEL		absorption coefficient
SPECIES SURFACE FACTOR	HCL	0.000
CLOUD SHAPE		ELLIPTICAL
CALCULATION HEIGHT		STABILIZATION
PROPELLANT TEMPERATURE (DEG. C)		22.86
CONCENTRATION AVERAGING TIME (SEC.)		3600.00
mixing layer reflection coefficient (RNG- 0 TO 1,no reflection=0)		1.0000
DIFFUSION COEFFICIENTS	LATERAL	1.0000
	VERTICAL	1.0000
VEHICLE AIR ENTRAINMENT PARAMETER	GAMMAE	0.6400
DOWNWIND EXPANSION DISTANCE (METERS)	LATERAL	100.00
	VERTICAL	100.00

----- DATA FILES -----

INPUT FILES

RAWINSONDE FILE	a17a0132.raw
DATA BASE FILE	rdmbase.ksc

OUTPUT FILES

PRINT FILE	a17ah000.stb
PLOT FILE	a17ah000.stp

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 3
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RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- METEOROLOGICAL RAWINSONDE DATA -----

RAWINSONDE MSS/MSS
TIME- 0132 Z DATE- 08 NOV 97
ASCENT NUMBER 0

----- T -0.6 HR SOUNDING -----

MET. LEV. NO.	ALTITUDE MSL (FT)	ALTITUDE GND (FT)	WIND GND (M)	WIND DIR (DEG)	WIND SPEED (M/S)	WIND SPEED (KTS)	AIR TEMP (DEG C)	AIR PTEMP (DEG C)	AIR DPTEMP (DEG C)	AIR PRESS (MB)	AIR RH (%)	H M	INT-ERP
1	16	0.0	0.0	280	4.1	8.0	16.2	16.7	11.2	1011.2	72.0		
2	59	42.6	13.0	283	5.4	10.4	16.2	16.8	11.2	1009.7	72.2		**
3	101	85.2	26.0	286	6.6	12.8	16.1	16.9	11.1	1008.1	72.2		**
4	144	127.8	39.0	288	7.8	15.2	16.1	17.0	11.1	1006.6	72.2		**
5	186	170.4	51.9	291	9.1	17.6	16.0	17.1	11.0	1005.0	72.2		**
6	229	213.0	64.9	294	10.3	20.0	16.0	17.1	11.0	1003.5	72.0		
7	278	262.0	79.9	295	10.0	19.5	15.9	17.1	10.9	1001.7	72.4		**
8	327	311.0	94.8	295	9.8	19.0	15.7	17.1	10.8	1000.0	73.0		
9	495	479.3	146.1	296	9.6	18.7	15.3	17.2	10.7	994.0	74.3		**
10	664	647.5	197.4	297	9.5	18.4	14.9	17.3	10.7	988.0	76.0		**
11	832	815.8	248.6	298	9.3	18.1	14.4	17.4	10.6	982.0	77.7		**
12	1000	984.0	299.9	299	9.2	17.8	14.0	17.4	10.5	976.1	79.0		
13	1271	1255.0	382.5	299	8.7	17.0	13.3	17.6	10.5	966.7	83.0		
14	1510	1494.0	455.4	300	8.5	16.5	12.6	17.6	10.5	958.3	87.1		**
15	1749	1733.0	528.2	300	8.2	16.0	11.9	17.6	10.5	950.0	91.0		
16	1802	1786.0	544.4	300	8.2	16.0	11.8	17.7	10.5	948.3	92.0		
17	2000	1984.0	604.7	300	8.1	15.8	11.3	17.7	10.1	941.5	92.0		
18	2337	2321.0	707.4	301	7.7	15.0	10.4	17.8	9.4	930.0	93.0		
19	2947	2931.0	893.4	299	7.2	14.0	9.1	18.2	8.1	909.5	94.0		
20	3000	2984.0	909.5	299	7.2	14.0	9.0	18.3	8.0	907.7	94.0		
21	3227	3211.0	978.7	298	7.2	14.0	8.5	18.5	7.7	900.0	95.0		
22	3568	3552.0	1082.6	296	7.2	14.0	7.8	18.7	7.2	889.0	96.0	*	
23	4000	3984.0	1214.3	292	7.7	14.9	8.7	20.6	0.9	875.0	61.0		
24	4162	4146.0	1263.7	291	7.7	15.0	9.0	21.3	-1.5	869.8	48.0		
25	4781	4765.0	1452.4	286	9.3	18.0	10.0	24.1	-5.0	850.0	34.0		
26	5000	4984.0	1519.1	285	9.5	18.4	9.6	24.4	-5.3	843.4	35.0		
27	5500	5484.0	1671.5	281	10.5	20.4	9.0	25.4	-5.9	828.1	34.9		**
28	6000	5984.0	1823.9	277	11.5	22.4	8.5	26.3	-6.5	813.0	34.0		
29	6426	6410.0	1953.8	274	12.3	24.0	8.1	27.3	-7.1	800.0	33.0		
30	7000	6984.0	2128.7	270	13.5	26.3	7.9	28.8	-7.6	783.6	32.0		
31	7500	7484.0	2281.1	269	14.5	28.2	7.3	29.8	-8.2	769.2	33.2		**
32	8000	7984.0	2433.5	267	15.5	30.1	6.7	30.8	-8.8	755.2	32.0		
33	8170	8154.0	2485.3	267	15.9	31.0	6.5	31.1	-9.1	750.0	32.0		
34	9109	9093.0	2771.5	267	18.0	35.0	5.1	32.6	-10.3	724.7	32.0		

* - INDICATES THE CALCULATED TOP OF THE SURFACE MIXING LAYER
** - INDICATES THAT DATA IS LINEARLY INTERPOLATED FROM INPUT METEOROLOGY

----- METEOROLOGICAL RAWINSONDE DATA -----

SURFACE AIR DENSITY (GM/M**3)	1211.43
DEFAULT CALCULATED MIXING LAYER HEIGHT (M)	1082.65
CLOUD COVER IN TENTHS OF CELESTIAL DOME	0.0
CLOUD CEILING (M)	9999.0

----- PLUME RISE DATA -----

EXHAUST RATE OF MATERIAL INTO GRN CLD-	(GRAMS/SEC)		4.21733E+06
TOTAL GROUND CLD MATERIAL-	(GRAMS)		3.96943E+07
HEAT OUTPUT PER GRAM-	(CALORIES)		1555.6
VEHICLE RISE HEIGHT DEFINING GROUND CLD-	(M)		199.9
VEHICLE RISE TIME PARAMETERS-	(TK=(A*Z**B)+C)	A=	0.8677
		B=	0.4500
		C=	0.0000
EXHAUST RATE OF MATERIAL INTO CONTRAIL-	(GRAMS/SEC)		4.21733E+06
CONTRAIL HEAT OUTPUT PER GRAM-	(CALORIES)		1555.6

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----- EXHAUST CLOUD -----

MET. LAYER NO.	TOP OF LAYER (METERS)	CLOUD RISE TIME (SECONDS)		CLOUD RISE RANGE (METERS)	CLOUD RISE BEARING (DEGREES)	STABILIZED CLOUD RANGE (METERS)	STABILIZED CLOUD BEARING (DEGREES)
1	13.0	1.8		4.0	100.8	0.0	0.0
2	26.0	2.8		11.5	102.1	0.0	0.0
3	39.0	3.8		18.0	103.4	0.0	0.0
4	51.9	4.8		25.5	104.9	0.0	0.0
5	64.9	5.7		34.3	106.6	0.0	0.0
6	79.9	6.9		45.3	108.3	0.0	0.0
7	94.8	8.2		57.6	109.6	0.0	0.0
8	146.1	13.2		87.9	111.6	0.0	0.0
9	197.4	19.1		140.3	113.2	0.0	0.0
10	248.6	26.1		201.3	114.4	0.0	0.0
11	299.9	34.0		270.2	115.3	0.0	0.0
12	382.5	48.5		372.2	116.3	2437.3	118.6
13	455.4	63.3		500.6	117.0	2361.4	118.8
14	528.2	79.8		633.3	117.5	2300.1	119.1
15	544.4	83.8		718.2	117.8	2326.9	119.3
16	604.7	99.3		798.1	118.0	2269.6	119.3
17	707.4	129.3		981.8	118.4	2169.3	119.6
18	893.4	208.6		1399.6	119.1	1926.7	119.3
19	909.5	220.3		1732.0	119.1	2157.0	119.1
20	978.7	279.3	*	2199.0	119.1	2199.0	119.1
21	1082.6	279.3	*	2199.0	119.1	2199.0	119.1
22	1214.3	279.3	*	2199.0	119.1	2199.0	119.1
23	1263.7	279.3	*	2199.0	119.1	2199.0	119.1
24	1452.4	279.3	*	2199.0	119.1	2199.0	119.1
25	1519.1	279.3	*	2199.0	119.1	2199.0	119.1
26	1671.5	279.3	*	2199.0	119.1	2199.0	119.1
27	1823.9	279.3	*	2199.0	119.1	2199.0	119.1
28	1953.8	279.3	*	2199.0	119.1	2199.0	119.1
29	2128.7	279.3	*	2199.0	119.1	2199.0	119.1
30	2281.1	279.3	*	2199.0	119.1	2199.0	119.1
31	2433.5	279.3	*	2199.0	119.1	2199.0	119.1
32	2485.3	279.3	*	2199.0	119.1	2199.0	119.1
33	2771.5	279.3	*	2199.0	119.1	2199.0	119.1

* - INDICATES CLOUD STABILIZATION TIME WAS USED

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----- EXHAUST CLOUD -----

CHEMICAL SPECIES = HCL

MET. LAYER NO.	TOP OF LAYER (METERS)		LAYER SOURCE STRENGTH (GRAMS)	CLOUD UPDRAFT VELOCITY (M/S)	CLOUD RADIUS (METERS)	STD. DEVIATION MATERIAL DIST. ALONGWIND (METERS)	CROSSWIND (METERS)
1	13.0		0.00000E+00	11.5	0.0	0.0	0.0
2	26.0		0.00000E+00	13.4	0.0	0.0	0.0
3	39.0		0.00000E+00	13.6	0.0	0.0	0.0
4	51.9		0.00000E+00	13.3	0.0	0.0	0.0
5	64.9		0.00000E+00	12.8	0.0	0.0	0.0
6	79.9		0.00000E+00	12.1	0.0	0.0	0.0
7	94.8		0.00000E+00	11.4	0.0	0.0	0.0
8	146.1		0.00000E+00	9.4	0.0	0.0	0.0
9	197.4		0.00000E+00	7.9	0.0	0.0	0.0
10	248.6		0.00000E+00	6.9	0.0	0.0	0.0
11	299.9		0.00000E+00	6.1	0.0	0.0	0.0
12	382.5		5.32352E+04	5.3	20.3	9.4	9.4
13	455.4		3.40015E+05	4.7	331.5	154.5	154.5
14	528.2		6.18797E+05	4.2	446.7	208.2	208.2
15	544.4		1.70843E+05	4.1	497.8	231.9	231.9
16	604.7		7.33920E+05	3.7	534.1	248.9	248.9
17	707.4		1.54277E+06	3.1	594.1	276.8	276.8
18	893.4		3.39962E+06	1.5	657.2	306.2	306.2
19	909.5		3.14576E+05	1.3	675.4	314.7	314.7
20	978.7	*	1.59094E+06	0.0	677.3	315.6	315.6
21	1082.6	*	2.73687E+06	0.0	670.8	312.6	312.6
22	1214.3	*	3.17219E+06	0.0	638.6	297.6	297.6
23	1263.7	*	1.06109E+06	0.0	593.2	276.4	276.4
24	1452.4	*	3.12286E+06	0.0	497.0	231.6	231.6
25	1519.1	*	6.61100E+05	0.0	308.4	143.7	143.7
26	1671.5	*	8.94115E+05	0.0	220.6	102.8	102.8
27	1823.9	*	8.17373E+05	0.0	199.9	93.2	93.2
28	1953.8	*	6.67215E+05	0.0	199.9	93.2	93.2
29	2128.7	*	8.61534E+05	0.0	199.9	93.2	93.2
30	2281.1	*	7.19226E+05	0.0	199.9	93.2	93.2
31	2433.5	*	6.93253E+05	0.0	199.9	93.2	93.2
32	2485.3	*	2.30241E+05	0.0	199.9	93.2	93.2
33	2771.5	*	1.22659E+06	0.0	199.9	93.2	93.2

* - INDICATES CLOUD STABILIZATION TIME WAS USED

----- CLOUD STABILIZATION -----

CALCULATION HEIGHT	(METERS)	946.82
STABILIZATION HEIGHT	(METERS)	946.82
STABILIZATION TIME	(SECS)	279.27
FIRST MIXING LAYER HEIGHT-	(METERS)	TOP = 1082.65
		BASE= 0.00
SECOND SELECTED LAYER HEIGHT-	(METERS)	TOP = 2771.55
		BASE= 1082.65
SIGMAR(AZ) AT THE SURFACE	(DEGREES)	5.4936
SIGMER(EL) AT THE SURFACE	(DEGREES)	3.6919

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
1	4.95	1.23	281.40	2.80	4.7661	3.6919
2	5.97	1.23	284.20	2.80	3.8775	3.6919
3	7.20	1.23	287.00	2.80	3.7041	3.6919
4	8.44	1.23	289.80	2.80	3.6919	3.6919
5	9.67	1.23	292.60	2.80	3.6919	3.6919
6	10.16	0.26	294.25	0.50	3.6919	3.6919
7	9.90	0.26	294.75	0.50	3.6919	3.6919
8	9.70	-0.15	295.50	1.00	3.5937	3.5937
9	9.54	-0.15	296.50	1.00	3.4252	3.4252
10	9.39	-0.15	297.50	1.00	3.2847	3.2847
11	9.23	-0.15	298.50	1.00	3.1228	3.1228
12	8.95	-0.41	299.00	0.00	2.9246	2.9246
13	8.62	-0.26	299.25	0.50	2.7184	2.7184
14	8.36	-0.26	299.75	0.50	2.5577	2.5577
15	8.23	0.00	300.00	0.00	2.4443	2.4443
16	8.18	-0.10	300.00	0.00	2.2802	2.2802
17	7.92	-0.41	300.50	1.00	1.9709	1.9709
18	7.46	-0.51	300.00	-2.00	1.6348	1.6348
19	7.20	0.00	299.00	0.00	1.4379	1.4379
20	7.20	0.00	298.50	-1.00	1.2609	1.2609
21	7.20	0.00	297.00	-2.00	1.0712	1.0712
22	7.43	0.46	294.00	-4.00	1.0000	1.0000
23	7.69	0.05	291.50	-1.00	1.0000	1.0000
24	8.49	1.54	288.50	-5.00	1.0000	1.0000
25	9.36	0.21	285.50	-1.00	1.0000	1.0000
26	9.98	1.03	283.00	-4.00	1.0000	1.0000
27	11.01	1.03	279.00	-4.00	1.0000	1.0000
28	11.94	0.82	275.50	-3.00	1.0000	1.0000
29	12.94	1.18	272.00	-4.00	1.0000	1.0000
30	14.02	0.98	269.25	-1.50	1.0000	1.0000

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----- CALCULATED METEOROLOGICAL LAYER PARAMETERS -----

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
31	15.00	0.98	267.75	-1.50	1.0000	1.0000
32	15.72	0.46	267.00	0.00	1.0000	1.0000
33	16.98	2.06	267.00	0.00	1.0000	1.0000

ALTITUDE RANGE USED IN COMPUTING TRANSITION LAYER AVERAGES
IS 197.4 TO 2771.5 METERS.

TRANSITION LAYER NUMBER- 1

VALUE AT	HEIGHT (METERS)	TEMP. (DEG K)	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIR. (DEG)	WIND DIR. SHEAR (DEG)	SIGMA AZI. (DEG)	SIGMA ELE. (DEG)
TOP-	1082.65	291.90	7.20		296.00		1.0000	1.0000
LAYER-			8.04	0.74	299.16	1.38	2.1008	2.1008
BOTTOM-	0.00	289.86	4.12		280.00		5.4936	3.6919

TRANSITION LAYER NUMBER- 2

VALUE AT	HEIGHT (METERS)	TEMP. (DEG K)	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIR. (DEG)	WIND DIR. SHEAR (DEG)	SIGMA AZI. (DEG)	SIGMA ELE. (DEG)
TOP-	2771.55	305.74	18.01		267.00		1.0000	1.0000
LAYER-			12.12	3.33	274.57	8.14	1.0000	1.0000
BOTTOM-	1082.65	291.90	7.20		296.00		1.0000	1.0000

----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
3000.0051	119.2659	25.1542	4.0147	7.7211
4000.0288	119.3777	22.0962	3.8257	9.7964
5000.0000	119.1429	19.6682	5.8178	11.8739
6000.0015	119.1972	17.6732	7.8754	13.9538
7000.0000	119.1677	15.9303	9.9289	16.0359
8000.0005	119.1455	14.3550	11.9786	18.1202
9000.0010	119.1283	12.9174	14.0246	20.2067
10000.0029	119.1145	11.6028	16.0445	22.2953
11000.0059	119.1032	10.4041	18.0596	24.3859
12000.0098	119.2328	9.3177	20.0746	26.4784
13000.0088	119.2273	8.3408	22.0896	28.5729
14000.0078	119.2225	7.4684	24.1045	30.6691
15000.0078	119.2184	6.6949	26.1194	32.7670
16000.0068	119.2147	6.0136	28.1343	34.8666
17000.0059	119.2115	5.4167	30.1492	36.9677
18000.0059	119.2087	4.8957	32.1641	39.0703
19000.0059	119.2062	4.4423	34.1790	41.1742
20000.0059	119.2039	4.0483	36.1939	43.2795
21000.0059	119.2018	3.7060	38.2087	45.3860
22000.0059	119.1999	3.4081	40.2236	47.4937
23000.0059	119.1982	3.1484	42.2385	49.6025
24000.0039	119.1966	2.9212	44.2533	51.7124
25000.0039	119.1952	2.7215	46.2682	53.8232
26000.0039	119.1938	2.5450	48.2830	55.9349
27000.0039	119.1926	2.3881	50.2979	58.0475
28000.0039	119.1915	2.2478	52.3127	60.1609
29000.0039	119.1904	2.1216	54.3276	62.2751
30000.0039	119.1894	2.0072	56.3424	64.3900
31000.0039	119.1885	1.9030	58.3572	66.5055
32000.0039	119.1876	1.8076	60.3721	68.6218
33000.0039	119.1868	1.7198	62.3869	70.7386
34000.0039	119.1860	1.6386	64.4018	72.8559
35000.0039	119.1852	1.5633	66.4166	74.9738
36000.0039	119.1846	1.4932	68.4314	77.0922
37000.0039	119.1839	1.4277	70.4463	79.2111

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----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
38000.0039	119.1833	1.3664	72.4611	81.3305
39000.0039	119.1827	1.3089	74.4759	83.4502
40000.0039	119.1821	1.2549	76.4908	85.5704
41000.0039	119.1816	1.2041	78.5056	87.6909
42000.0039	119.1811	1.1562	80.5204	89.8118
43000.0039	119.1806	1.1111	82.5353	91.9330
44000.0039	119.1802	1.0684	84.5501	94.0545
45000.0039	119.1797	1.0281	86.5649	96.1764
46000.0039	119.1793	0.9899	88.5798	98.2985
47000.0039	119.1789	0.9538	90.5946	100.4209
48000.0039	119.1785	0.9195	92.6094	102.5436
49000.0039	119.1781	0.8870	94.6242	104.6665
50000.0039	119.1778	0.8562	96.6391	106.7896
51000.0039	119.1775	0.8268	98.6539	108.9130
52000.0039	119.1771	0.7989	100.6687	111.0366
53000.0039	119.1768	0.7724	102.6835	113.1603
54000.0039	119.1765	0.7471	104.6984	115.2843
55000.0039	119.1762	0.7230	106.7132	117.4085
56000.0039	119.1759	0.7000	108.7280	119.5328
57000.0039	119.1757	0.6781	110.7429	121.6573
58000.0039	119.1754	0.6571	112.7577	123.7819
59000.0000	119.1751	0.6371	114.7725	125.9068
60000.0000	119.1749	0.6180	116.7873	128.0317

	RANGE	BEARING
25.154 IS THE MAXIMUM PEAK CONCENTRATION	3000.0	119.3

1**********

ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 11
VERSION 7.08 AT KSC
1005 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

****

----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	60.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
3000.0051	119.2659	0.6852	4.0147	7.7211
4000.0288	119.3777	0.5999	3.8257	9.7964
5000.0000	119.1429	0.5343	5.8178	11.8739
6000.0015	119.1972	0.4808	7.8754	13.9538
7000.0000	119.1677	0.4339	9.9289	16.0359
8000.0005	119.1455	0.3914	11.9786	18.1202
9000.0010	119.1283	0.3531	14.0246	20.2067
10000.0029	119.1145	0.3186	16.0445	22.2953
11000.0059	119.1032	0.2877	18.0596	24.3859
12000.0098	119.2328	0.2602	20.0746	26.4784
13000.0088	119.2273	0.2357	22.0896	28.5729
14000.0078	119.2225	0.2140	24.1045	30.6691
15000.0078	119.2184	0.1949	26.1194	32.7670
16000.0068	119.2147	0.1781	28.1343	34.8666
17000.0059	119.2115	0.1634	30.1492	36.9677
18000.0059	119.2087	0.1505	32.1641	39.0703
19000.0059	119.2062	0.1393	34.1790	41.1742
20000.0059	119.2039	0.1296	36.1939	43.2795
21000.0059	119.2018	0.1211	38.2087	45.3860
22000.0059	119.1999	0.1138	40.2236	47.4937
23000.0059	119.1982	0.1075	42.2385	49.6025
24000.0039	119.1966	0.1019	44.2533	51.7124
25000.0039	119.1952	0.0971	46.2682	53.8232
26000.0039	119.1938	0.0928	48.2830	55.9349
27000.0039	119.1926	0.0891	50.2979	58.0475
28000.0039	119.1915	0.0857	52.3127	60.1609
29000.0039	119.1904	0.0827	54.3276	62.2751
30000.0039	119.1894	0.0800	56.3424	64.3900
31000.0039	119.1885	0.0775	58.3572	66.5055
32000.0039	119.1876	0.0752	60.3721	68.6218
33000.0039	119.1868	0.0731	62.3869	70.7386
34000.0039	119.1860	0.0712	64.4018	72.8559
35000.0039	119.1852	0.0694	66.4166	74.9738
36000.0039	119.1846	0.0676	68.4314	77.0922

1**********

ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 12
VERSION 7.08 AT KSC
1005 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

****

----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	60.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
37000.0039	119.1839	0.0660	70.4463	79.2111
38000.0039	119.1833	0.0645	72.4611	81.3305
39000.0039	119.1827	0.0630	74.4759	83.4502
40000.0039	119.1821	0.0616	76.4908	85.5704
41000.0039	119.1816	0.0603	78.5056	87.6909
42000.0039	119.1811	0.0590	80.5204	89.8118
43000.0039	119.1806	0.0578	82.5353	91.9330
44000.0039	119.1802	0.0566	84.5501	94.0545
45000.0039	119.1797	0.0555	86.5649	96.1764
46000.0039	119.1793	0.0544	88.5798	98.2985
47000.0039	119.1789	0.0534	90.5946	100.4209
48000.0039	119.1785	0.0524	92.6094	102.5436
49000.0039	119.1781	0.0514	94.6242	104.6665
50000.0039	119.1778	0.0505	96.6391	106.7896
51000.0039	119.1775	0.0496	98.6539	108.9130
52000.0039	119.1771	0.0487	100.6687	111.0366
53000.0039	119.1768	0.0479	102.6835	113.1603
54000.0039	119.1765	0.0471	104.6984	115.2843
55000.0039	119.1762	0.0463	106.7132	117.4085
56000.0039	119.1759	0.0456	108.7280	119.5328
57000.0039	119.1757	0.0449	110.7429	121.6573
58000.0039	119.1754	0.0441	112.7577	123.7819
59000.0000	119.1751	0.0435	114.7725	125.9068
60000.0000	119.1749	0.0428	116.7873	128.0317

	RANGE	BEARING
0.685 IS THE MAXIMUM 60.0 MIN. MEAN CONCENTRATION	3000.0	119.3

*** REEDM HAS TERMINATED

Surface Impact Predictions

This section includes the REEDM version 7.08 output for the surface impact run. For the surface impact run, we included the plots of the rawinsonde meteorological data, the predicted maximum concentration versus downwind distance, and the predicted concentration isopleths overlayed on a range map. The rawinsonde meteorological data is identical to the data plotted in Figure 1 for the stabilization height run. Lastly this section includes the detailed REEDM report for this run. The first page of the REEDM output is its listing of errors and is not included in this appendix.

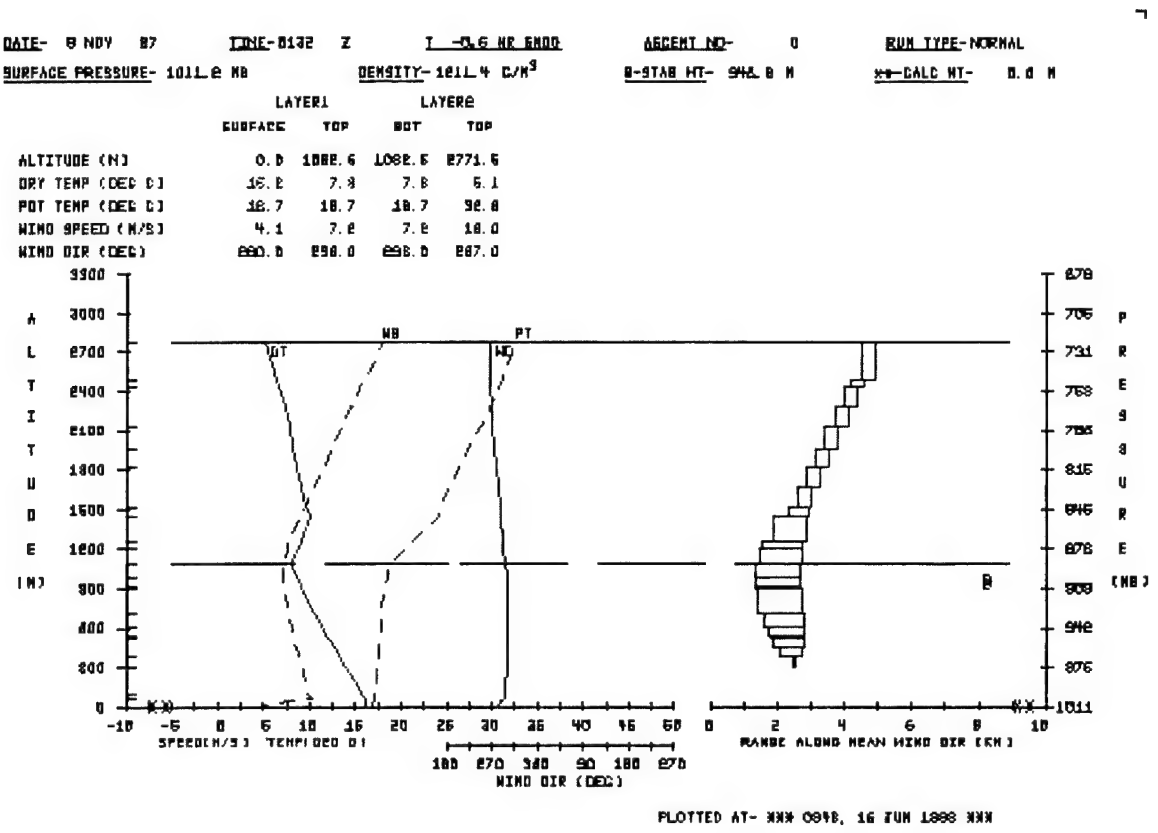

Figure 4A. Meteorological output plot from REEDM Version 7.08 for A-17 mission Uusing T-0.6h rawinsonde data.

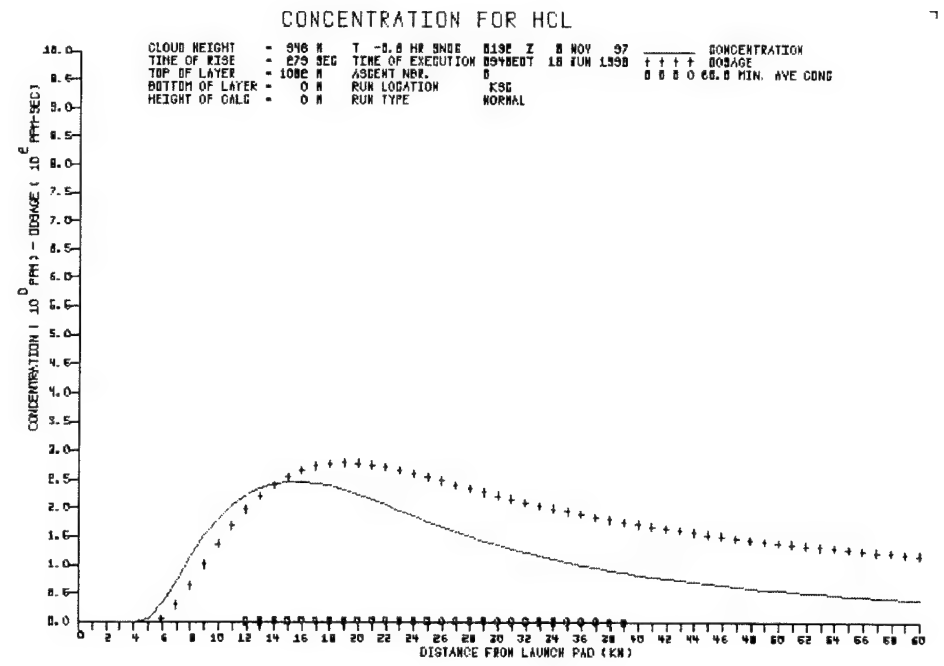

Figure 5A. HCl surface height concentration predictions from REEDM Version 7.08 for A-17 mission using T-0.6h rawinsonde data.

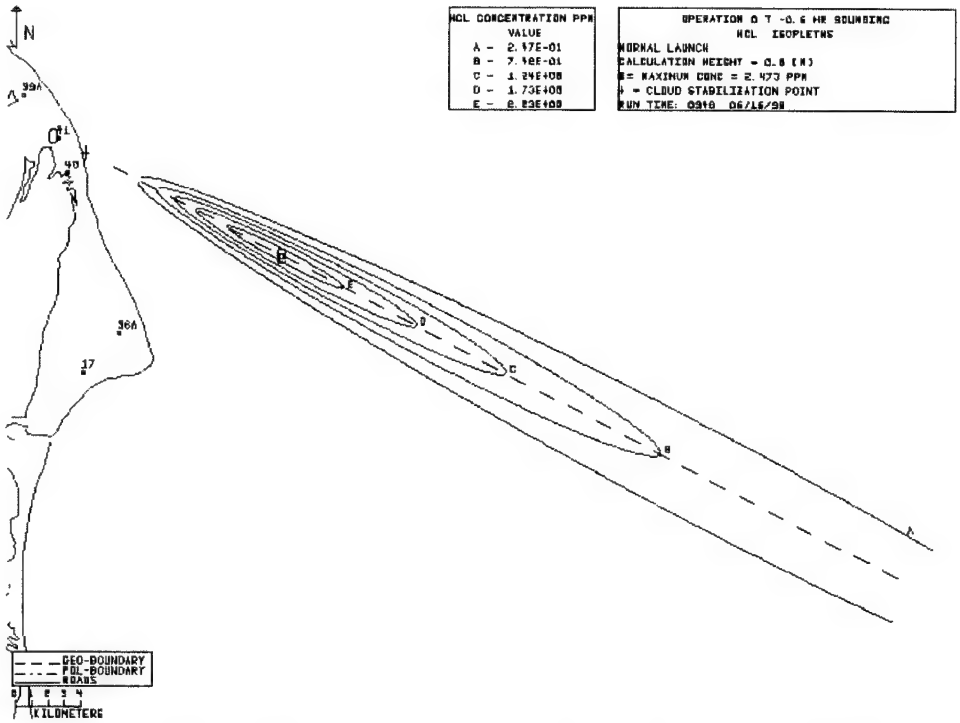

Figure 6A. HCl surface height concentration isopleth predictions from REEDM Version 7.08 for A-17 mission using T-0.6h rawinsonde data.

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1*************************************************************************
                ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM        PAGE    2
                          VERSION 7.08 AT  KSC
                          0948 EDT 16 JUN 1998
                      launch time:  2105 EST 07 NOV 1997
     RAWINSONDE ASCENT NUMBER      0, 0132   Z  8 NOV   97  T  -0.6 HR
 *************************************************************************

                          ----- PROGRAM OPTIONS -----

 MODEL                                                          CONCENTRATION
 RUN TYPE                                                      OPERATIONAL
 WIND-FIELD TERRAIN EFFECTS MODEL                                      NONE
 LAUNCH VEHICLE                                                   TITAN IV
 LAUNCH TYPE                                                       NORMAL
 LAUNCH COMPLEX NUMBER                                                 41
 TURBULENCE PARAMETERS ARE DETERMINED FROM                 CLIMATOLOGICAL DATA
 SURFACE CHEMISTRY MODEL                                absorption coefficient
 SPECIES      SURFACE FACTOR                                HCL          0.000
 CLOUD SHAPE                                                       ELLIPTICAL
 CALCULATION HEIGHT                                                   SURFACE
 PROPELLANT TEMPERATURE (DEG. C)                                        22.86
 CONCENTRATION AVERAGING TIME (SEC.)                                  3600.00
 mixing layer reflection coefficient (RNG- 0 TO 1,no reflection=0)      1.0000
 DIFFUSION COEFFICIENTS                                  LATERAL        1.0000
                                                         VERTICAL       1.0000
 VEHICLE AIR ENTRAINMENT PARAMETER                       GAMMAE         0.6400
 DOWNWIND EXPANSION DISTANCE (METERS)                    LATERAL      100.00
                                                         VERTICAL     100.00

                          ----- DATA FILES -----

                               INPUT FILES
 RAWINSONDE FILE                                                 a17a0132.raw
 DATA BASE FILE                                                   rdmbase.ksc

                               OUTPUT FILES
 PRINT FILE                                                      u17ah000.sur
 PLOT FILE                                                       u17ah000.sup
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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 3
VERSION 7.08 AT KSC
0948 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- METEOROLOGICAL RAWINSONDE DATA -----

RAWINSONDE MSS/MSS
TIME- 0132 Z DATE- 08 NOV 97
ASCENT NUMBER 0

----- T -0.6 HR SOUNDING -----

MET. LEV. NO.	ALTITUDE MSL (FT)	ALTITUDE GND (FT)	GND (M)	WIND DIR (DEG)	WIND SPEED (M/S)	WIND SPEED (KTS)	AIR TEMP (DEG C)	AIR PTEMP (DEG C)	AIR DPTEMP (DEG C)	AIR PRESS (MB)	AIR RH (%)	H M	INT-ERP
1	16	0.0	0.0	280	4.1	8.0	16.2	16.7	11.2	1011.2	72.0		
2	59	42.6	13.0	283	5.4	10.4	16.2	16.8	11.2	1009.7	72.2		**
3	101	85.2	26.0	286	6.6	12.8	16.1	16.9	11.1	1008.1	72.2		**
4	144	127.8	39.0	288	7.8	15.2	16.1	17.0	11.1	1006.6	72.2		**
5	186	170.4	51.9	291	9.1	17.6	16.0	17.1	11.0	1005.0	72.2		**
6	229	213.0	64.9	294	10.3	20.0	16.0	17.1	11.0	1003.5	72.0		
7	278	262.0	79.9	295	10.0	19.5	15.9	17.1	10.9	1001.7	72.4		**
8	327	311.0	94.8	295	9.8	19.0	15.7	17.1	10.8	1000.0	73.0		
9	495	479.3	146.1	296	9.6	18.7	15.3	17.2	10.7	994.0	74.3		**
10	664	647.5	197.4	297	9.5	18.4	14.9	17.3	10.7	988.0	76.0		**
11	832	815.8	248.6	298	9.3	18.1	14.4	17.4	10.6	982.0	77.7		**
12	1000	984.0	299.9	299	9.2	17.8	14.0	17.4	10.5	976.1	79.0		
13	1271	1255.0	382.5	299	8.7	17.0	13.3	17.6	10.5	966.7	83.0		
14	1510	1494.0	455.4	300	8.5	16.5	12.6	17.6	10.5	958.3	87.1		**
15	1749	1733.0	528.2	300	8.2	16.0	11.9	17.6	10.5	950.0	91.0		
16	1802	1786.0	544.4	300	8.2	16.0	11.8	17.7	10.5	948.3	92.0		
17	2000	1984.0	604.7	300	8.1	15.8	11.3	17.7	10.1	941.5	92.0		
18	2337	2321.0	707.4	301	7.7	15.0	10.4	17.8	9.4	930.0	93.0		
19	2947	2931.0	893.4	299	7.2	14.0	9.1	18.2	8.1	909.5	94.0		
20	3000	2984.0	909.5	299	7.2	14.0	9.0	18.3	8.0	907.7	94.0		
21	3227	3211.0	978.7	298	7.2	14.0	8.5	18.5	7.7	900.0	95.0		
22	3568	3552.0	1082.6	296	7.2	14.0	7.8	18.7	7.2	889.0	96.0	*	
23	4000	3984.0	1214.3	292	7.7	14.9	8.7	20.6	0.9	875.0	61.0		
24	4162	4146.0	1263.7	291	7.7	15.0	9.0	21.3	-1.5	869.8	48.0		
25	4781	4765.0	1452.4	286	9.3	18.0	10.0	24.1	-5.0	850.0	34.0		
26	5000	4984.0	1519.1	285	9.5	18.4	9.6	24.4	-5.3	843.4	35.0		
27	5500	5484.0	1671.5	281	10.5	20.4	9.0	25.4	-5.9	828.1	34.9		**
28	6000	5984.0	1823.9	277	11.5	22.4	8.5	26.3	-6.5	813.0	34.0		
29	6426	6410.0	1953.8	274	12.3	24.0	8.1	27.3	-7.1	800.0	33.0		
30	7000	6984.0	2128.7	270	13.5	26.3	7.9	28.8	-7.6	783.6	32.0		
31	7500	7484.0	2281.1	269	14.5	28.2	7.3	29.8	-8.2	769.2	33.2		**
32	8000	7984.0	2433.5	267	15.5	30.1	6.7	30.8	-8.8	755.2	32.0		
33	8170	8154.0	2485.3	267	15.9	31.0	6.5	31.1	-9.1	750.0	32.0		
34	9109	9093.0	2771.5	267	18.0	35.0	5.1	32.6	-10.3	724.7	32.0		

* - INDICATES THE CALCULATED TOP OF THE SURFACE MIXING LAYER
** - INDICATES THAT DATA IS LINEARLY INTERPOLATED FROM INPUT METEOROLOGY

----- METEOROLOGICAL RAWINSONDE DATA -----

SURFACE AIR DENSITY (GM/M**3)	1211.43
DEFAULT CALCULATED MIXING LAYER HEIGHT (M)	1082.65
CLOUD COVER IN TENTHS OF CELESTIAL DOME	0.0
CLOUD CEILING (M)	9999.0

----- PLUME RISE DATA -----

EXHAUST RATE OF MATERIAL INTO GRN CLD-	(GRAMS/SEC)		4.21733E+06
TOTAL GROUND CLD MATERIAL-	(GRAMS)		3.96943E+07
HEAT OUTPUT PER GRAM-	(CALORIES)		1555.6
VEHICLE RISE HEIGHT DEFINING GROUND CLD-	(M)		199.9
VEHICLE RISE TIME PARAMETERS-	(TK=(A*Z**B)+C)	A=	0.8677
		B=	0.4500
		C=	0.0000
EXHAUST RATE OF MATERIAL INTO CONTRAIL-	(GRAMS/SEC)		4.21733E+06
CONTRAIL HEAT OUTPUT PER GRAM-	(CALORIES)		1555.6

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 5
VERSION 7.08 AT KSC
0948 EDT 16 JUN 1998
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****

----- EXHAUST CLOUD -----

MET. LAYER NO.	TOP OF LAYER (METERS)	CLOUD RISE TIME (SECONDS)		CLOUD RISE RANGE (METERS)	CLOUD RISE BEARING (DEGREES)	STABILIZED CLOUD RANGE (METERS)	STABILIZED CLOUD BEARING (DEGREES)
1	13.0	1.8		4.0	100.8	0.0	0.0
2	26.0	2.8		11.5	102.1	0.0	0.0
3	39.0	3.8		18.0	103.4	0.0	0.0
4	51.9	4.8		25.5	104.9	0.0	0.0
5	64.9	5.7		34.3	106.6	0.0	0.0
6	79.9	6.9		45.3	108.3	0.0	0.0
7	94.8	8.2		57.6	109.6	0.0	0.0
8	146.1	13.2		87.9	111.6	0.0	0.0
9	197.4	19.1		140.3	113.2	0.0	0.0
10	248.6	26.1		201.3	114.4	0.0	0.0
11	299.9	34.0		270.2	115.3	0.0	0.0
12	382.5	48.5		372.2	116.3	2437.3	118.6
13	455.4	63.3		500.6	117.0	2361.4	118.8
14	528.2	79.8		633.3	117.5	2300.1	119.1
15	544.4	83.8		718.2	117.8	2326.9	119.3
16	604.7	99.3		798.1	118.0	2269.6	119.3
17	707.4	129.3		981.8	118.4	2169.3	119.6
18	893.4	208.6		1399.6	119.1	1926.7	119.3
19	909.5	220.3		1732.0	119.1	2157.0	119.1
20	978.7	279.3	*	2199.0	119.1	2199.0	119.1
21	1082.6	279.3	*	2199.0	119.1	2199.0	119.1
22	1214.3	279.3	*	2199.0	119.1	2199.0	119.1
23	1263.7	279.3	*	2199.0	119.1	2199.0	119.1
24	1452.4	279.3	*	2199.0	119.1	2199.0	119.1
25	1519.1	279.3	*	2199.0	119.1	2199.0	119.1
26	1671.5	279.3	*	2199.0	119.1	2199.0	119.1
27	1823.9	279.3	*	2199.0	119.1	2199.0	119.1
28	1953.8	279.3	*	2199.0	119.1	2199.0	119.1
29	2128.7	279.3	*	2199.0	119.1	2199.0	119.1
30	2281.1	279.3	*	2199.0	119.1	2199.0	119.1
31	2433.5	279.3	*	2199.0	119.1	2199.0	119.1
32	2485.3	279.3	*	2199.0	119.1	2199.0	119.1
33	2771.5	279.3	*	2199.0	119.1	2199.0	119.1

* - INDICATES CLOUD STABILIZATION TIME WAS USED

----- EXHAUST CLOUD -----

CHEMICAL SPECIES = HCL

MET. LAYER NO.	TOP OF LAYER (METERS)		LAYER SOURCE STRENGTH (GRAMS)	CLOUD UPDRAFT VELOCITY (M/S)	CLOUD RADIUS (METERS)	STD. DEVIATION MATERIAL DIST. ALONGWIND (METERS)	CROSSWIND (METERS)
1	13.0		0.00000E+00	11.5	0.0	0.0	0.0
2	26.0		0.00000E+00	13.4	0.0	0.0	0.0
3	39.0		0.00000E+00	13.6	0.0	0.0	0.0
4	51.9		0.00000E+00	13.3	0.0	0.0	0.0
5	64.9		0.00000E+00	12.8	0.0	0.0	0.0
6	79.9		0.00000E+00	12.1	0.0	0.0	0.0
7	94.8		0.00000E+00	11.4	0.0	0.0	0.0
8	146.1		0.00000E+00	9.4	0.0	0.0	0.0
9	197.4		0.00000E+00	7.9	0.0	0.0	0.0
10	248.6		0.00000E+00	6.9	0.0	0.0	0.0
11	299.9		0.00000E+00	6.1	0.0	0.0	0.0
12	382.5		5.32352E+04	5.3	20.3	9.4	9.4
13	455.4		3.40015E+05	4.7	331.5	154.5	154.5
14	528.2		6.18797E+05	4.2	446.7	208.2	208.2
15	544.4		1.70843E+05	4.1	497.8	231.9	231.9
16	604.7		7.33920E+05	3.7	534.1	248.9	248.9
17	707.4		1.54277E+06	3.1	594.1	276.8	276.8
18	893.4		3.39962E+06	1.5	657.2	306.2	306.2
19	909.5		3.14576E+05	1.3	675.4	314.7	314.7
20	978.7	*	1.59094E+06	0.0	677.3	315.6	315.6
21	1082.6	*	2.73687E+06	0.0	670.8	312.6	312.6
22	1214.3	*	3.17219E+06	0.0	638.6	297.6	297.6
23	1263.7	*	1.06109E+06	0.0	593.2	276.4	276.4
24	1452.4	*	3.12286E+06	0.0	497.0	231.6	231.6
25	1519.1	*	6.61100E+05	0.0	308.4	143.7	143.7
26	1671.5	*	8.94115E+05	0.0	220.6	102.8	102.8
27	1823.9	*	8.17373E+05	0.0	199.9	93.2	93.2
28	1953.8	*	6.67215E+05	0.0	199.9	93.2	93.2
29	2128.7	*	8.61534E+05	0.0	199.9	93.2	93.2
30	2281.1	*	7.19226E+05	0.0	199.9	93.2	93.2
31	2433.5	*	6.93253E+05	0.0	199.9	93.2	93.2
32	2485.3	*	2.30241E+05	0.0	199.9	93.2	93.2
33	2771.5	*	1.22659E+06	0.0	199.9	93.2	93.2

* - INDICATES CLOUD STABILIZATION TIME WAS USED

----- CLOUD STABILIZATION -----

CALCULATION HEIGHT	(METERS)	0.00
STABILIZATION HEIGHT	(METERS)	946.82
STABILIZATION TIME	(SECS)	279.27
FIRST MIXING LAYER HEIGHT-	(METERS)	TOP = 1082.65
		BASE= 0.00
SECOND SELECTED LAYER HEIGHT-	(METERS)	TOP = 2771.55
		BASE= 1082.65
SIGMAR(AZ) AT THE SURFACE	(DEGREES)	5.4936
SIGMER(EL) AT THE SURFACE	(DEGREES)	3.6919

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
1	4.95	1.23	281.40	2.80	4.7661	3.6919
2	5.97	1.23	284.20	2.80	3.8775	3.6919
3	7.20	1.23	287.00	2.80	3.7041	3.6919
4	8.44	1.23	289.80	2.80	3.6919	3.6919
5	9.67	1.23	292.60	2.80	3.6919	3.6919
6	10.16	0.26	294.25	0.50	3.6919	3.6919
7	9.90	0.26	294.75	0.50	3.6919	3.6919
8	9.70	-0.15	295.50	1.00	3.5937	3.5937
9	9.54	-0.15	296.50	1.00	3.4252	3.4252
10	9.39	-0.15	297.50	1.00	3.2847	3.2847
11	9.23	-0.15	298.50	1.00	3.1228	3.1228
12	8.95	-0.41	299.00	0.00	2.9246	2.9246
13	8.62	-0.26	299.25	0.50	2.7184	2.7184
14	8.36	-0.26	299.75	0.50	2.5577	2.5577
15	8.23	0.00	300.00	0.00	2.4443	2.4443
16	8.18	-0.10	300.00	0.00	2.2802	2.2802
17	7.92	-0.41	300.50	1.00	1.9709	1.9709
18	7.46	-0.51	300.00	-2.00	1.6348	1.6348
19	7.20	0.00	299.00	0.00	1.4379	1.4379
20	7.20	0.00	298.50	-1.00	1.2609	1.2609
21	7.20	0.00	297.00	-2.00	1.0712	1.0712
22	7.43	0.46	294.00	-4.00	1.0000	1.0000
23	7.69	0.05	291.50	-1.00	1.0000	1.0000
24	8.49	1.54	288.50	-5.00	1.0000	1.0000
25	9.36	0.21	285.50	-1.00	1.0000	1.0000
26	9.98	1.03	283.00	-4.00	1.0000	1.0000
27	11.01	1.03	279.00	-4.00	1.0000	1.0000
28	11.94	0.82	275.50	-3.00	1.0000	1.0000
29	12.94	1.18	272.00	-4.00	1.0000	1.0000
30	14.02	0.98	269.25	-1.50	1.0000	1.0000

----- CALCULATED METEOROLOGICAL LAYER PARAMETERS -----

MET. LAYER NO.	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIRECTION (DEG)	WIND DIRECTION SHEAR (DEG)	SIGMA OF AZI ANG (DEG)	SIGMA OF ELE ANG (DEG)
31	15.00	0.98	267.75	-1.50	1.0000	1.0000
32	15.72	0.46	267.00	0.00	1.0000	1.0000
33	16.98	2.06	267.00	0.00	1.0000	1.0000

ALTITUDE RANGE USED IN COMPUTING TRANSITION LAYER AVERAGES
IS 0.0 TO 1671.5 METERS.

TRANSITION LAYER NUMBER- 1

VALUE AT	HEIGHT (METERS)	TEMP. (DEG K)	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIR. (DEG)	WIND DIR. SHEAR (DEG)	SIGMA AZI. (DEG)	SIGMA ELE. (DEG)
TOP-	1082.65	291.90	7.20		296.00		1.0000	1.0000
LAYER-			8.19	0.99	298.07	2.69	2.3866	2.3723
BOTTOM-	0.00	289.86	4.12		280.00		5.4936	3.6919

TRANSITION LAYER NUMBER- 2

VALUE AT	HEIGHT (METERS)	TEMP. (DEG K)	WIND SPEED (M/SEC)	WIND SPEED SHEAR (M/SEC)	WIND DIR. (DEG)	WIND DIR. SHEAR (DEG)	SIGMA AZI. (DEG)	SIGMA ELE. (DEG)
TOP-	2771.55	305.74	18.01		267.00		1.0000	1.0000
LAYER-			8.65	1.12	287.77	4.79	1.0000	1.0000
BOTTOM-	1082.65	291.90	7.20		296.00		1.0000	1.0000

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 9
VERSION 7.08 AT KSC
0948 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
5000.0771	118.3876	0.0612	5.7198	11.0884
6000.0771	118.3600	0.3364	7.7304	13.7964
7000.0396	118.2621	0.7278	9.7345	15.8472
8000.0835	118.3311	1.1417	11.7138	17.9017
9000.0605	118.2800	1.5164	13.6748	19.9596
10000.0439	118.2392	1.8227	15.6357	22.0207
11000.0313	118.2058	2.0596	17.5966	24.0849
12000.1328	118.3387	2.2353	19.5574	26.1521
13000.1230	118.3180	2.3584	21.5183	28.2219
14000.1143	118.3002	2.4352	23.4791	30.2944
15000.1064	118.2848	2.4716	25.4399	32.3692
16000.0996	118.2713	2.4733	27.4006	34.4462
17000.0938	118.2594	2.4460	29.3614	36.5253
18000.0879	118.2488	2.3952	31.3222	38.6063
19000.0840	118.2393	2.3264	33.2829	40.6890
20000.0801	118.2308	2.2444	35.2436	42.7734
21000.0762	118.2231	2.1536	37.2044	44.8593
22000.0723	118.2161	2.0578	39.1651	46.9465
23000.0684	118.2097	1.9597	41.1259	49.0351
24000.0664	118.2038	1.8619	43.0866	51.1248
25000.0645	118.1985	1.7660	45.0473	53.2156
26000.0605	118.1935	1.6733	47.0081	55.3074
27000.0586	118.1889	1.5846	48.9688	57.4001
28000.0566	118.1846	1.5005	50.9295	59.4937
29000.0547	118.1806	1.4212	52.8902	61.5881
30000.0527	118.1769	1.3467	54.8510	63.6832
31000.0508	118.1734	1.2770	56.8117	65.7791
32000.0488	118.1701	1.2118	58.7724	67.8755
33000.0469	118.1671	1.1509	60.7331	69.9726
34000.0469	118.1642	1.0942	62.6938	72.0702
35000.0469	118.1615	1.0412	64.6546	74.1683
36000.0430	118.1589	0.9918	66.6153	76.2669
37000.0430	118.1565	0.9457	68.5760	78.3660
38000.0430	118.1542	0.9025	70.5367	80.4654
39000.0391	118.1520	0.8621	72.4974	82.5653

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 10
VERSION 7.08 AT KSC
0948 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	PEAK CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
40000.0391	118.1499	0.8243	74.4581	84.6655
41000.0391	118.1479	0.7888	76.4189	86.7661
42000.0391	118.1461	0.7555	78.3796	88.8670
43000.0352	118.1443	0.7242	80.3403	90.9682
44000.0352	118.1426	0.6947	82.3010	93.0697
45000.0352	118.1409	0.6670	84.2617	95.1714
46000.0352	118.1394	0.6408	86.2224	97.2734
47000.0352	118.1379	0.6162	88.1831	99.3757
48000.0313	118.1364	0.5929	90.1438	101.4782
49000.0313	118.1350	0.5709	92.1046	103.5808
50000.0313	118.1337	0.5500	94.0653	105.6837
51000.0313	118.1325	0.5302	96.0260	107.7868
52000.0313	118.1312	0.5115	97.9867	109.8901
53000.0313	118.1301	0.4937	99.9474	111.9935
54000.0313	118.1289	0.4769	101.9081	114.0971
55000.0273	118.1278	0.4608	103.8688	116.2009
56000.0273	118.1268	0.4456	105.8295	118.3048
57000.0273	118.1258	0.4310	107.7902	120.4088
58000.0273	118.1248	0.4172	109.7509	122.5130
59000.0273	118.1239	0.4040	111.7117	124.6173
60000.0273	118.1229	0.3914	113.6724	126.7217

	RANGE	BEARING
2.473 IS THE MAXIMUM PEAK CONCENTRATION	16000.1	118.3

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 11
VERSION 7.08 AT KSC
0948 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	60.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
6000.0771	118.3600	0.0030	7.7304	13.7964
7000.0396	118.2621	0.0096	9.7345	15.8472
8000.0835	118.3311	0.0190	11.7138	17.9017
9000.0605	118.2800	0.0294	13.6748	19.9596
10000.0439	118.2392	0.0393	15.6357	22.0207
11000.1445	118.3632	0.0483	17.5966	24.0849
12000.1328	118.3387	0.0561	19.5574	26.1521
13000.1230	118.3180	0.0627	21.5183	28.2219
14000.1143	118.3002	0.0681	23.4791	30.2944
15000.1064	118.2848	0.0723	25.4399	32.3692
16000.0996	118.2713	0.0754	27.4006	34.4462
17000.0938	118.2594	0.0775	29.3614	36.5253
18000.0879	118.2488	0.0786	31.3222	38.6063
19000.0840	118.2393	0.0790	33.2829	40.6890
20000.0801	118.2308	0.0788	35.2436	42.7734
21000.0762	118.2231	0.0780	37.2044	44.8593
22000.0723	118.2161	0.0769	39.1651	46.9465
23000.0684	118.2097	0.0755	41.1259	49.0351
24000.0664	118.2038	0.0739	43.0866	51.1248
25000.0645	118.1985	0.0721	45.0473	53.2156
26000.0605	118.1935	0.0703	47.0081	55.3074
27000.0586	118.1889	0.0685	48.9688	57.4001
28000.0566	118.1846	0.0666	50.9295	59.4937
29000.0547	118.1806	0.0648	52.8902	61.5881
30000.0527	118.1769	0.0631	54.8510	63.6832
31000.0508	118.1734	0.0614	56.8117	65.7791
32000.0488	118.1701	0.0598	58.7724	67.8755
33000.0469	118.1671	0.0582	60.7331	69.9726
34000.0469	118.1642	0.0567	62.6938	72.0702
35000.0469	118.1615	0.0553	64.6546	74.1683
36000.0430	118.1589	0.0539	66.6153	76.2669
37000.0430	118.1565	0.0526	68.5760	78.3660
38000.0430	118.1542	0.0514	70.5367	80.4654
39000.0391	118.1520	0.0502	72.4974	82.5653

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ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM PAGE 12
VERSION 7.08 AT KSC
0948 EDT 16 JUN 1998
launch time: 2105 EST 07 NOV 1997
RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR

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----- MAXIMUM CENTERLINE CALCULATIONS -----

** DECAY COEFFICIENT (1/SEC) = 0.00000E+00 **

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS
DOWNWIND FROM A TITAN IV NORMAL LAUNCH
CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

RANGE FROM PAD (METERS)	BEARING FROM PAD (DEGREES)	60.0 MIN. MEAN CONCEN-TRATION (PPM)	CLOUD ARRIVAL TIME (MIN)	CLOUD DEPARTURE TIME (MIN)
40000.0391	118.1499	0.0491	74.4581	84.6655
41000.0391	118.1479	0.0480	76.4189	86.7661
42000.0391	118.1461	0.0470	78.3796	88.8670
43000.0352	118.1443	0.0460	80.3403	90.9682
44000.0352	118.1426	0.0450	82.3010	93.0697
45000.0352	118.1409	0.0441	84.2617	95.1714
46000.0352	118.1394	0.0433	86.2224	97.2734
47000.0352	118.1379	0.0424	88.1831	99.3757
48000.0313	118.1364	0.0416	90.1438	101.4782
49000.0313	118.1350	0.0408	92.1046	103.5808
50000.0313	118.1337	0.0401	94.0653	105.6837
51000.0313	118.1325	0.0393	96.0260	107.7868
52000.0313	118.1312	0.0386	97.9867	109.8901
53000.0313	118.1301	0.0380	99.9474	111.9935
54000.0313	118.1289	0.0373	101.9081	114.0971
55000.0273	118.1278	0.0367	103.8688	116.2009
56000.0273	118.1268	0.0361	105.8295	118.3048
57000.0273	118.1258	0.0355	107.7902	120.4088
58000.0273	118.1248	0.0349	109.7509	122.5130
59000.0273	118.1239	0.0344	111.7117	124.6173
60000.0273	118.1229	0.0338	113.6724	126.7217

	RANGE	BEARING
0.079 IS THE MAXIMUM 60.0 MIN. MEAN CONCENTRATION	19000.1	118.2

*** REEDM HAS TERMINATED

Appendix B—Meteorological Data for Launch of Titan IVA-17

This appendix contains three types of meteorological data recorded before and after the Titan IVA-17 launch at Cape Canaveral Air Station. The launch occurred at 2105 EST on 7 November 1997 (0205Z on 8 November 1997).

Rawinsonde Data

This vertical meteorological data file was provided by a rawinsonde balloon released from CCAS at 0132Z (T–33 minutes).

915-MHz Radar Profiler Data

These vertical meteorological data files were provided by five 915-MHz radar profilers located on and near CCAS. The data are 10-min averages of windspeed and direction that begin at 0150Z and end at 0215Z.

Meteorological Tower Data

These data files were provided by a series of meteorological towers located on and adjacent to CCAS. The data are averaged over 5 min. The first entry is at 0205Z and the last entry is at 0215Z. Data are taken at the elevation (Z) above tower base, and includes wind direction (DIR), windspeed (SPD) in knots, temperature (T) in °F, and dewpoint (TD) in °F.

Rawinsonde File

RS013120132
TEST NBR A0597 WS7 1500
RAWINSONDE MSS/MSS
CAPE CANAVERAL AFS, FLORIDA
0132Z 08 NOV 97

ALT GEOMFT	DIR DEG	SPD KTS	SHR /SEC	TEMP DEG C	DPT DEG C	PRESS MBS	RH PCT	ABHUM G/M3	DENSITY G/M3	I/R N	V/S KTS	VPS MBS	PW MM
16	280	8.0	.000	16.2	11.2	1011.20	72	9.95	1211.43	330	665	13.28	0
1000	299	17.8	.018	14.0	10.5	976.13	79	9.58	1178.42	321	662	12.69	3
2000	300	15.8	.003	11.3	10.1	941.46	92	9.41	1147.40	314	659	12.35	6
3000	299	14.0	.003	9.0	8.0	907.71	94	8.27	1115.79	300	656	10.77	8
4000	292	14.9	.003	8.7	.9	874.96	61	5.20	1078.45	273	655	6.76	11
5000	285	18.4	.007	9.6	-5.3	843.44	35	3.16	1037.46	251	656	4.12	12
6000	277	22.4	.008	8.5	-6.5	813.01	34	2.89	1003.90	242	655	3.75	13
7000	270	26.3	.008	7.9	-7.6	783.58	32	2.65	969.69	233	654	3.44	13
8000	267	30.1	.007	6.7	-8.8	755.15	32	2.44	938.53	224	653	3.15	14
9000	267	34.0	.007	5.3	-10.2	727.63	32	2.19	909.09	216	651	2.82	15
10000	265	39.1	.009	4.1	-11.4	700.97	31	2.00	879.74	209	649	2.56	16
11000	262	43.8	.009	4.6	-11.5	675.24	30	1.97	845.77	201	650	2.53	16
12000	259	45.3	.004	2.1	-12.8	650.40	32	1.80	821.98	195	647	2.28	17
13000	259	45.2	.001	-.2	-14.8	626.26	32	1.54	798.31	188	644	1.94	17
14000	259	45.2	.001	-2.8	-16.9	602.82	33	1.31	775.87	181	641	1.63	18
15000	260	46.2	.002	-5.5	-19.2	580.02	33	1.08	754.29	175	638	1.34	18
16000	261	48.1	.003	-8.1	-21.1	557.89	34	.92	732.68	169	635	1.13	18
17000	261	49.9	.003	-10.5	-22.8	536.39	36	.80	711.05	164	632	.98	19
18000	262	51.2	.003	-13.2	-25.0	515.52	36	.67	690.59	158	629	.80	19
19000	263	52.3	.002	-15.7	-27.2	495.27	36	.55	669.87	153	626	.66	19
20000	264	53.5	.003	-18.5	-29.0	475.62	39	.47	650.33	148	622	.55	19
21000	264	54.9	.003	-21.2	-30.9	456.55	41	.40	630.99	143	619	.46	19
22000	264	56.4	.003	-23.6	-33.4	438.05	40	.32	611.47	138	616	.36	19
23000	264	58.0	.003	-26.3	-35.4	420.14	41	.26	592.68	134	613	.29	19
24000	264	60.1	.004	-28.9	-37.7	402.77	42	.21	574.44	129	609	.23	19
25000	265	63.3	.005	-31.0	-40.0	385.96	40	.16	555.12	125	607	.18	20
26000	266	67.9	.008	-31.4	-41.6	369.77	36	.14	532.88	120	606	.16	20
27000	267	74.2	.011	-32.8	-42.8	354.21	36	.12	513.32	115	604	.14	20
28000	268	81.7	.013	-33.3	-43.5	339.24	35	.11	492.68	111	604	.13	20
29000	270	87.3	.010	-34.4	-44.4	324.86	35	.10	473.93	106	602	.12	20
30000	272	90.7	.007	-35.3	-45.2	311.05	35	.10	455.58	102	601	.11	20
31000	999	999.0	.999	-36.5	-46.3	297.76	35	.09	438.20	98	600	.09	20
32000	999	999.0	.999	-38.9	-48.9	284.94	33	.06	423.71	95	597	.07	20

TERMINATION 32304 GEOPFT 9846 GEOPM 279.9 MBS
TROPOPAUSE 0 FEET .00 MB .0 C .0 C

MANDATORY LEVELS

GEOPFT	DIR	KTS	TEMP	DPT	PRESS	RH
327	295	19	15.7	10.8	1000.0	73
1749	300	16	11.9	10.5	950.0	91
3227	298	14	8.5	7.7	900.0	95
4781	286	18	10.0	-5.0	850.0	34
6426	274	24	8.1	-7.1	800.0	33
8170	267	31	6.5	-9.1	750.0	32

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 10018 265  39    4.0 -11.4  700.0  31
 11992 259  45    2.1 -12.9  650.0  32
 14092 259  45   -3.1 -17.1  600.0  33
 16327 261  49   -8.9 -21.7  550.0  34
 18720 263  52  -15.1 -26.7  500.0  36
 21298 264  55  -22.1 -31.8  450.0  41
 24100 264  61  -29.3 -38.1  400.0  42
 27203 267  76  -33.2 -43.1  350.0  36
 30739 272  92  -36.3 -46.0  300.0  35
SIGNIFICANT LEVELS
GEOMFT DIR KTS  TEMP   DPT PRESS   IR  RH

    16 280   8  16.2  11.2 1011.2 330  72
   229 294  20  16.0  11.0 1003.5 328  72
  1271 299  17  13.3  10.5  966.7 320  83
  1802 300  16  11.8  10.5  948.3 317  92
  2337 301  15  10.4   9.4  930.0 309  93
  2947 299  14   9.1   8.1  909.5 301  94
  3568 296  14   7.8   7.2  889.0 294  96
  4162 291  15   9.0  -1.5  869.8 265  48
  4772 287  17  10.0  -5.0  850.5 253  34
  9109 267  35   5.1 -10.3  724.7 216  32
 11004 262  44   4.6 -11.5  675.1 201  30
 21121 264  55 -21.5 -31.2  454.3 143  41
 23185 264  58 -26.8 -35.9  416.9 133  42
 24503 264  61 -30.2 -38.9  394.3 127  42
 30979 272  93 -36.4 -46.2  298.0  98  35
 31737 999 999 -38.3 -48.4  288.3  96  33
 32401 999 999 -39.8 -49.7  279.9  94  33
TERMINATION
040 040
NNNN
```

915 Mhz Radar Files

DATE: 11/08/1997 SITE NAME: RWP0001
LATITUDE: 28.44 LONGITUDE: -80.58 ELEVATION: 10 ft
AZIMUTH 1: 174 AZIMUTH 2: 84
NYQUIST: 19.6 kts

CTIMEZ	BTIMEZ	NM	HGT	WS	WD	RV1	NS1	SNR1	RV2	NS2	SNR2	VV	NSV	NMN	SNRV
hhmmss	hhmmss	min	ft	kts	deg	kts	#	db	kts	#	db	kts	#	#	db
020050	015024	10	383.4	999.9	9999	-5.5	4	3	-4.3	5	14	0.1	7	5	12
020050	015024	10	699.1	999.9	9999	-4.9	4	7	-3.9	5	19	-0.1	7	5	13
020050	015024	10	1014.8	999.9	9999	-6.4	4	5	-3.4	6	35	0.3	7	5	14
020050	015024	10	1330.5	999.9	9999	-6.0	3	5	-2.6	5	38	-1.0	7	5	18
020050	015024	10	1646.3	999.9	9999	-5.0	3	3	-2.5	6	22	-0.2	7	5	30
020050	015024	10	1962.0	14.6	316	-4.8	8	6	-3.7	6	16	-0.2	7	5	26
020050	015024	10	2277.7	999.9	9999	-4.8	5	4	-3.9	4	30	-0.2	7	5	16
020050	015024	10	2593.4	999.9	9999	-5.6	4	0	2.5	2	7	0.0	5	5	-6
020050	015024	10	2909.1	999.9	9999	-7.8	3	-5	9.2	3	7	0.0	7	5	-7
020050	015024	10	3224.9	999.9	9999	-2.3	6	-9	10.2	3	10	0.0	8	5	-3
020050	015024	10	3540.6	8.2	289	-1.2	8	0	-2.8	6	-7	0.0	8	5	0
020050	015024	10	3856.3	9.3	281	-1.0	8	-4	-3.4	6	-5	0.0	8	5	-5
020050	015024	10	4172.0	999.9	9999	-2.0	8	-7	-4.1	4	-9	14.7	3	5	-17
020050	015024	10	4487.7	999.9	9999	-3.1	8	-12	-4.7	3	-17	-0.8	3	5	-18
020050	015024	10	4803.5	20.0	274	-1.2	5	-17	-7.6	5	-19	1.1	4	5	-12
020050	015024	10	5119.2	12.8	291	-2.2	5	-18	-4.4	5	-17	-16.6	2	5	-18
020050	015024	10	5434.9	999.9	9999	2.8	4	-17	10.4	4	-18	-3.5	3	5	-4
020050	015024	10	5750.6	999.9	9999	4.1	4	-17	12.4	3	-9	-17.7	3	5	-19
020050	015024	10	6066.3	999.9	9999	2.8	3	-20	16.7	4	-20	5.0	2	5	-19
020050	015024	10	6382.1	999.9	9999	3.4	3	-16	-6.1	2	-18	-11.8	4	5	-17
020050	015024	10	6697.8	999.9	9999	6.8	4	-17	-10.7	2	-14	18.6	4	5	-20
020050	015024	10	7013.5	999.9	9999	-0.4	3	7	10.0	2	-18	10.2	3	5	-18
020050	015024	10	7329.2	999.9	9999	11.9	3	-19	14.3	3	-18	-4.9	3	5	-19
020050	015024	10	7644.9	999.9	9999	-2.6	2	-18	4.2	2	-18	-11.9	2	5	-19
020050	015024	10	7960.7	999.9	9999	-2.0	4	-20	4.1	3	-15	13.8	3	5	-19
020050	015024	10	8276.4	999.9	9999	3.3	2	-12	-17.3	2	-17	-17.0	4	5	-15
020050	015024	10	8592.1	999.9	9999	-4.9	3	-20	6.4	3	-18	5.0	3	5	-17
020050	015024	10	8907.8	999.9	9999	11.2	3	-14	14.1	3	-19	6.2	3	5	-19
020050	015024	10	9223.5	999.9	9999	16.6	3	-18	16.0	2	-18	-13.7	3	5	-17
020050	015024	10	9539.3	999.9	9999	-7.2	2	-18	11.8	2	-17	6.7	3	5	-16
020050	015024	10	9855.0	999.9	9999	-17.5	3	-19	-1.3	2	-20	-6.4	3	5	-16
020050	015024	10	10170.7	999.9	9999	-16.3	4	-16	10.0	3	-15	11.5	3	5	-17
021534	020528	9	383.4	999.9	9999	-7.1	2	6	-3.3	3	32	0.1	7	5	30
021534	020528	9	699.1	999.9	9999	-12.4	3	16	-4.0	4	35	0.1	7	5	32
021534	020528	9	1014.8	999.9	9999	-17.0	3	22	4.3	3	30	0.2	7	5	25
021534	020528	9	1330.5	999.9	9999	-14.0	4	23	-4.3	3	29	0.0	7	5	34
021534	020528	9	1646.3	999.9	9999	0.0	2	13	-5.7	3	29	0.0	6	5	26
021534	020528	9	1962.0	999.9	9999	-4.7	4	7	8.9	2	19	-0.4	6	5	22
021534	020528	9	2277.7	999.9	9999	-5.3	3	6	7.5	2	13	-0.9	5	5	14
021534	020528	9	2593.4	999.9	9999	-6.3	3	23	-0.7	2	14	0.6	6	5	-1
021534	020528	9	2909.1	999.9	9999	-4.7	2	-5	-1.5	3	5	0.2	8	5	-12
021534	020528	9	3224.9	999.9	9999	-0.9	4	-11	-1.3	3	-11	0.0	8	5	3
021534	020528	9	3540.6	7.2	277	-0.5	7	-1	-2.6	7	1	0.0	8	5	8
021534	020528	9	3856.3	10.3	282	-1.0	7	2	-3.5	6	3	0.2	8	5	8
021534	020528	9	4172.0	999.9	9999	-2.6	7	0	-3.8	4	-1	0.3	8	5	-4
021534	020528	9	4487.7	999.9	9999	-3.0	6	-7	-4.5	4	-10	0.4	3	5	31

021534	020528	9	4803.5	17.9	283	-2.0	6	0	-6.3	5	-13	0.2	5	5	31
021534	020528	9	5119.2	17.7	297	-3.5	5	-7	-5.4	6	-11	0.3	6	5	14
021534	020528	9	5434.9	999.9	9999	-3.2	4	-15	-6.8	5	-13	-5.4	2	5	-20
021534	020528	9	5750.6	999.9	9999	17.4	3	-16	16.5	3	-12	-1.3	3	5	18
021534	020528	9	6066.3	999.9	9999	-11.3	3	-12	12.7	3	-12	-12.2	2	5	-16
021534	020528	9	6382.1	999.9	9999	17.8	3	-17	14.9	2	-19	-1.7	3	5	-7
021534	020528	9	6697.8	999.9	9999	-12.4	2	-11	-6.6	3	-19	11.8	4	5	-6
021534	020528	9	7013.5	999.9	9999	15.1	2	-18	18.3	2	-16	10.7	2	5	-14
021534	020528	9	7329.2	999.9	9999	-10.0	2	-18	-9.3	3	-17	11.1	3	5	-18
021534	020528	9	7644.9	999.9	9999	-13.5	2	-20	-13.4	2	-20	-15.4	2	5	-19
021534	020528	9	7960.7	999.9	9999	4.8	3	-19	-18.3	3	-17	15.7	3	5	-19
021534	020528	9	8276.4	999.9	9999	-11.8	2	-18	8.2	4	-18	-18.3	3	5	-19
021534	020528	9	8592.1	999.9	9999	-9.2	2	-18	4.7	2	-15	12.6	3	5	-17
021534	020528	9	8907.8	999.9	9999	-17.3	2	-18	-3.0	2	-18	13.4	3	5	-17
021534	020528	9	9223.5	999.9	9999	11.4	3	-15	10.8	2	-18	5.9	4	5	-18
021534	020528	9	9539.3	999.9	9999	-9.6	2	-2	10.3	3	-19	6.6	3	5	-16
021534	020528	9	9855.0	999.9	9999	1.9	3	-19	-8.1	2	-18	2.1	3	5	-19
021534	020528	9	10170.7	999.9	9999	16.3	3	-18	-17.2	2	-18	-11.7	2	5	-17

DATE: 11/08/1997 SITE NAME: RWP0002
LATITUDE: 28.60 LONGITUDE: -80.59 ELEVATION: 10 ft
AZIMUTH 1: 2 AZIMUTH 2: 272
NYQUIST: 19.6 kts

CTIMEZ	BTIMEZ	NM	HGT	WS	WD	RV1	NS1	SNR1	RV2	NS2	SNR2	VV	NSV	NMN	SNR
hhmmss	hhmmss	min	ft	kts	deg	kts	#	db	kts	#	db	kts	#	#	db
020013	015017	9	383.4	999.9	9999	4.6	5	7	8.7	4	23	0.1	7	5	27
020013	015017	9	699.1	999.9	9999	4.8	4	8	6.0	3	21	-0.2	7	5	36
020013	015017	9	1014.8	999.9	9999	4.7	6	7	12.9	2	15	0.0	7	5	23
020013	015017	9	1330.5	999.9	9999	5.1	7	13	9.4	4	22	0.4	7	5	32
020013	015017	9	1646.3	999.9	9999	3.3	3	9	10.7	4	20	0.9	7	5	26
020013	015017	9	1962.0	999.9	9999	1.4	7	12	11.8	4	17	-0.8	6	5	32
020013	015017	9	2277.7	999.9	9999	0.8	6	1	1.0	4	0	-0.1	8	5	18
020013	015017	9	2593.4	3.1	338	0.7	7	-7	0.1	5	12	-0.3	8	5	0
020013	015017	9	2909.1	3.1	188	-1.0	6	-11	0.3	5	2	0.1	7	5	-7
020013	015017	9	3224.9	999.9	9999	0.0	5	-10	3.8	2	-14	-0.3	8	5	-12
020013	015017	9	3540.6	999.9	9999	-0.5	5	-13	3.0	4	-14	-0.1	8	5	-1
020013	015017	9	3856.3	5.4	283	0.3	7	-5	2.0	7	-7	0.0	8	5	1
020013	015017	9	4172.0	8.7	293	1.0	7	3	2.9	7	-2	-0.2	8	5	-5
020013	015017	9	4487.7	8.6	296	1.6	7	-1	3.3	7	-4	0.3	5	5	-13
020013	015017	9	4803.5	12.2	303	2.5	7	-12	4.1	7	-5	-12.8	2	5	-12
020013	015017	9	5119.2	999.9	9999	2.7	4	-16	5.4	4	-17	-0.9	3	5	-15
020013	015017	9	5434.9	999.9	9999	2.9	5	-16	-4.5	3	-19	-10.2	2	5	-20
020013	015017	9	5750.6	999.9	9999	11.5	2	-15	-17.4	2	-19	10.8	3	5	-17
020013	015017	9	6066.3	999.9	9999	17.7	3	-11	3.5	2	-19	-3.6	3	5	-20
020013	015017	9	6382.1	999.9	9999	-3.3	2	-18	-8.4	3	-16	7.6	3	5	-17
020013	015017	9	6697.8	999.9	9999	19.3	2	-18	14.6	3	-15	-1.3	3	5	-17
020013	015017	9	7013.5	999.9	9999	2.2	2	-19	-2.6	2	-20	-5.5	2	5	-18
020013	015017	9	7329.2	999.9	9999	-9.9	4	-18	11.9	3	-18	-10.0	3	5	-17
020013	015017	9	7644.9	999.9	9999	-14.3	3	-17	11.8	2	-15	7.7	3	5	-18
020013	015017	9	7960.7	999.9	9999	-14.6	2	-16	7.3	2	-16	-5.8	2	5	-15
020013	015017	9	8276.4	999.9	9999	6.7	3	-19	3.2	3	-17	13.5	2	5	-16
020013	015017	9	8592.1	999.9	9999	13.7	2	-16	-10.2	3	-18	-16.8	3	5	-20
020013	015017	9	8907.8	999.9	9999	16.2	3	-18	-13.2	3	-18	10.2	3	5	-18
020013	015017	9	9223.5	999.9	9999	4.7	3	-18	-0.2	2	-20	-14.6	4	5	-20

020013	015017	9	9539.3	999.9	9999	-5.3	3	-18	7.4	3	-19	2.9	3	5	-21
020013	015017	9	9855.0	999.9	9999	0.1	2	-20	-11.4	3	-19	4.5	3	5	-19
020013	015017	9	10170.7	999.9	9999	4.5	2	-17	-4.4	2	-19	-8.2	3	5	-18
021524	020520	9	383.4	999.9	9999	4.1	6	11	4.7	4	26	-0.2	7	5	8
021524	020520	9	699.1	999.9	9999	4.3	5	17	4.9	3	27	0.1	5	5	4
021524	020520	9	1014.8	999.9	9999	4.1	7	15	4.2	3	8	0.0	8	5	11
021524	020520	9	1330.5	999.9	9999	4.8	6	21	6.1	3	20	0.6	7	5	8
021524	020520	9	1646.3	999.9	9999	5.2	5	21	10.2	3	18	0.1	6	5	7
021524	020520	9	1962.0	999.9	9999	4.6	4	4	4.5	2	22	0.7	7	5	-1
021524	020520	9	2277.7	999.9	9999	2.4	5	-9	14.4	3	8	0.0	8	5	-6
021524	020520	9	2593.4	999.9	9999	1.1	7	-11	7.7	4	-7	0.0	8	5	-7
021524	020520	9	2909.1	999.9	9999	0.6	7	-10	6.3	4	-11	0.2	7	5	-13
021524	020520	9	3224.9	999.9	9999	-0.3	4	-13	6.2	4	-18	-0.1	7	5	-15
021524	020520	9	3540.6	999.9	9999	1.4	6	-16	1.9	2	-20	0.0	8	5	-4
021524	020520	9	3856.3	7.2	289	0.8	8	-2	2.6	7	-5	0.0	8	5	-1
021524	020520	9	4172.0	9.7	290	1.1	8	1	3.6	7	-4	0.0	8	5	-9
021524	020520	9	4487.7	11.5	295	1.8	8	-6	4.1	7	-11	4.1	3	5	-19
021524	020520	9	4803.5	999.9	9999	3.5	4	-19	4.3	2	-15	3.1	3	5	-18
021524	020520	9	5119.2	999.9	9999	-7.8	3	-17	5.4	4	-19	-15.1	3	5	-18
021524	020520	9	5434.9	999.9	9999	-4.7	3	-18	7.8	3	-18	2.7	2	5	-18
021524	020520	9	5750.6	999.9	9999	-14.7	3	-18	6.0	3	-7	8.6	3	5	-19
021524	020520	9	6066.3	999.9	9999	10.9	3	-18	5.8	2	-5	-19.3	2	5	-18
021524	020520	9	6382.1	999.9	9999	-7.5	2	-16	3.2	2	-18	-7.7	2	5	-17
021524	020520	9	6697.8	999.9	9999	4.2	2	-18	-10.7	3	-19	-12.3	6	5	-18
021524	020520	9	7013.5	999.9	9999	2.4	3	3	6.4	3	-19	-5.2	3	5	-18
021524	020520	9	7329.2	999.9	9999	3.4	3	2	-15.8	2	-21	-2.2	2	5	-16
021524	020520	9	7644.9	999.9	9999	-3.0	3	-18	-4.5	2	-17	11.7	3	5	-17
021524	020520	9	7960.7	999.9	9999	-3.7	2	-20	8.1	4	-18	-2.9	3	5	-18
021524	020520	9	8276.4	999.9	9999	-8.3	3	-18	17.3	2	-18	14.5	4	5	-18
021524	020520	9	8592.1	999.9	9999	-4.9	2	-19	2.0	3	-20	-10.2	2	5	-18
021524	020520	9	8907.8	999.9	9999	-13.3	3	-19	14.2	3	-19	2.9	3	5	-16
021524	020520	9	9223.5	999.9	9999	13.9	2	-18	15.4	3	-21	8.0	3	5	-17
021524	020520	9	9539.3	999.9	9999	2.5	3	-19	9.2	2	-18	-3.8	3	5	-16
021524	020520	9	9855.0	999.9	9999	-10.1	3	-17	-9.7	2	-18	6.9	3	5	-18
021524	020520	9	10170.7	999.9	9999	16.4	3	-19	18.2	2	-16	0.3	3	5	-19

DATE: 11/08/1997 SITE NAME: RWP0003
LATITUDE: 28.56 LONGITUDE: -80.66 ELEVATION: 10 ft
AZIMUTH 1: 287 AZIMUTH 2: 17
NYQUIST: 19.6 kts

CTIMEZ	BTIMEZ	NM	HGT	WS	WD	RV1	NS1	SNR1	RV2	NS2	SNR2	VV	NSV	NMN	SNRV
hhmmss	hhmmss	min	ft	kts	deg	kts	#	db	kts	#	db	kts	#	#	db
020153	015014	10	383.4	999.9	9999	3.5	4	28	2.2	5	20	0.2	5	5	26
020153	015014	10	699.1	999.9	9999	3.3	4	34	1.8	5	28	0.3	7	5	27
020153	015014	10	1014.8	999.9	9999	3.6	4	28	2.3	5	21	1.0	5	5	27
020153	015014	10	1330.5	999.9	9999	5.2	4	31	1.9	5	36	0.5	6	5	28
020153	015014	10	1646.3	999.9	9999	6.8	4	38	1.4	5	34	0.0	5	5	24
020153	015014	10	1962.0	999.9	9999	6.9	4	32	1.4	5	24	0.0	4	5	16
020153	015014	10	2277.7	999.9	9999	8.0	5	22	1.1	4	15	0.3	7	5	6
020153	015014	10	2593.4	19.4	291	7.5	6	10	0.5	5	6	0.0	8	5	1
020153	015014	10	2909.1	17.5	284	6.7	8	7	-0.3	5	0	0.0	5	5	-4
020153	015014	10	3224.9	19.2	278	6.9	7	-4	-1.5	5	-6	-0.4	6	5	-7
020153	015014	10	3540.6	8.0	283	2.9	8	1	-0.3	6	-1	-0.2	8	5	8

020153	015014	10	3856.3	8.6	278	3.5	8	9	-0.2	7	9	0.2	7	5	5
020153	015014	10	4172.0	11.1	296	4.4	8	5	0.8	7	6	0.1	7	5	-5
020153	015014	10	4487.7	12.8	301	4.9	8	-4	1.2	7	-3	0.0	7	5	-13
020153	015014	10	4803.5	14.4	303	5.5	7	-11	1.7	7	-8	0.2	7	5	-14
020153	015014	10	5119.2	21.0	295	7.9	8	-13	0.9	5	16	-0.1	5	5	-12
020153	015014	10	5434.9	999.9	9999	8.1	7	-13	-0.6	4	19	7.8	4	5	-20
020153	015014	10	5750.6	999.9	9999	9.5	5	-16	-0.8	4	8	18.1	2	5	-18
020153	015014	10	6066.3	999.9	9999	7.8	5	-15	13.3	3	-18	4.9	3	5	-17
020153	015014	10	6382.1	999.9	9999	-6.1	3	-18	-0.5	2	-7	0.9	4	5	-17
020153	015014	10	6697.8	999.9	9999	-8.8	2	-19	-15.1	2	-19	11.7	2	5	-18
020153	015014	10	7013.5	999.9	9999	8.4	3	-18	-2.8	3	-19	12.2	3	5	-17
020153	015014	10	7329.2	999.9	9999	-3.0	3	-18	-7.2	3	-17	8.6	2	5	-18
020153	015014	10	7644.9	999.9	9999	14.3	2	-20	8.9	3	-18	17.8	2	5	-18
020153	015014	10	7960.7	999.9	9999	6.0	2	-17	-17.9	2	-20	4.4	2	5	-17
020153	015014	10	8276.4	999.9	9999	16.1	2	-16	8.4	2	-16	14.6	2	5	-16
020153	015014	10	8592.1	999.9	9999	12.4	4	-17	-7.7	2	-17	-4.7	2	5	-21
020153	015014	10	8907.8	999.9	9999	-15.6	4	-17	-2.8	3	-20	8.1	2	5	-17
020153	015014	10	9223.5	999.9	9999	-2.9	3	-19	12.3	2	-19	4.2	3	5	-19
020153	015014	10	9539.3	999.9	9999	-6.5	2	-18	-2.2	2	-19	-4.0	3	5	-18
020153	015014	10	9855.0	999.9	9999	-2.0	2	-19	9.1	2	-19	6.5	2	5	-17
020153	015014	10	10170.7	999.9	9999	-12.5	3	-17	-15.5	2	-20	-17.0	3	5	-17
021519	020144	13	383.4	999.9	9999	7.5	5	27	2.0	5	9	-0.1	9	7	33
021519	020144	13	699.1	999.9	9999	3.3	5	31	3.1	3	40	-0.1	10	7	36
021519	020144	13	1014.8	999.9	9999	4.8	6	19	2.8	6	35	0.0	9	7	34
021519	020144	13	1330.5	999.9	9999	4.0	6	23	2.6	4	16	-0.3	8	7	44
021519	020144	13	1646.3	999.9	9999	6.4	8	16	3.3	6	30	0.0	9	7	33
021519	020144	13	1962.0	999.9	9999	8.4	7	19	4.7	4	33	0.0	9	7	27
021519	020144	13	2277.7	999.9	9999	7.3	6	7	3.1	6	22	-0.1	10	7	12
021519	020144	13	2593.4	999.9	9999	8.0	8	5	1.3	6	10	0.0	9	7	10
021519	020144	13	2909.1	999.9	9999	7.9	9	-2	-1.8	6	4	-0.2	9	7	-2
021519	020144	13	3224.9	17.5	274	6.3	9	-5	-1.8	8	0	-0.3	9	7	-6
021519	020144	13	3540.6	10.5	275	3.7	10	-4	-1.1	9	-4	-0.3	11	7	5
021519	020144	13	3856.3	10.1	287	3.6	10	5	-0.3	9	4	-0.3	11	7	2
021519	020144	13	4172.0	12.1	297	4.3	10	2	0.5	10	2	-0.2	11	7	-7
021519	020144	13	4487.7	11.7	296	4.6	10	-6	0.8	10	-6	0.0	7	7	4
021519	020144	13	4803.5	999.9	9999	5.7	9	-11	-6.9	4	-19	-0.3	6	7	17
021519	020144	13	5119.2	999.9	9999	6.7	4	-14	-0.3	5	9	-0.7	10	7	5
021519	020144	13	5434.9	19.4	273	7.3	8	-11	-1.8	8	25	2.7	5	7	-3
021519	020144	13	5750.6	999.9	9999	10.0	6	-13	-2.2	6	16	-12.2	3	7	-15
021519	020144	13	6066.3	999.9	9999	8.4	6	-10	-2.6	5	8	14.8	4	7	-12
021519	020144	13	6382.1	999.9	9999	17.3	3	-19	-3.5	4	-8	11.4	4	7	-18
021519	020144	13	6697.8	999.9	9999	10.0	4	-18	-2.8	3	-8	-11.3	4	7	-17
021519	020144	13	7013.5	999.9	9999	7.9	4	-16	10.7	3	-18	-11.6	4	7	-18
021519	020144	13	7329.2	999.9	9999	-16.9	4	-18	9.6	3	-16	4.9	4	7	-18
021519	020144	13	7644.9	999.9	9999	4.6	3	-16	-3.7	3	-12	6.1	5	7	-4
021519	020144	13	7960.7	999.9	9999	3.8	3	-18	11.6	3	-8	9.7	3	7	-18
021519	020144	13	8276.4	999.9	9999	3.8	2	-17	-14.9	4	-18	-6.7	4	7	-17
021519	020144	13	8592.1	999.9	9999	3.0	3	-17	12.6	3	-9	-11.2	4	7	-16
021519	020144	13	8907.8	999.9	9999	-8.2	3	-20	17.7	5	-18	-16.6	3	7	-17
021519	020144	13	9223.5	999.9	9999	-16.6	3	-14	-7.4	3	-20	6.7	3	7	-17
021519	020144	13	9539.3	999.9	9999	-12.8	4	-17	2.4	4	-20	16.9	3	7	-17
021519	020144	13	9855.0	999.9	9999	-18.5	3	-18	7.7	4	-18	-3.2	4	7	-18
021519	020144	13	10170.7	999.9	9999	-14.0	3	-19	-13.2	4	-19	-13.4	2	7	-17

DATE: 11/08/1997 SITE NAME: RWP0004
LATITUDE: 28.69 LONGITUDE: -80.72 ELEVATION: 10 ft
AZIMUTH 1: 130 AZIMUTH 2: 220
NYQUIST: 19.6 kts

CTIMEZ hhmmss	BTIMEZ hhmmss	NM min	HGT ft	WS kts	WD deg	RV1 kts	NS1 #	SNR1 db	RV2 kts	NS2 #	SNR2 db	VV kts	NSV #	NMN #	SNRV db
020021	015029	9	383.4	999.9	9999	-7.0	7	13	-4.0	4	22	-0.2	8	5	31
020021	015029	9	699.1	17.7	338	-6.4	6	15	-3.5	6	27	-0.3	8	5	26
020021	015029	9	1014.8	18.1	331	-7.1	7	15	-3.0	5	23	-0.6	7	5	40
020021	015029	9	1330.5	24.5	330	-9.2	5	18	-3.6	5	32	-0.3	8	5	33
020021	015029	9	1646.3	999.9	9999	-7.6	4	17	-1.1	5	20	0.3	8	5	28
020021	015029	9	1962.0	999.9	9999	-12.9	3	31	-2.0	5	13	-0.2	8	5	21
020021	015029	9	2277.7	999.9	9999	-13.4	3	25	-1.1	5	7	-0.5	8	5	14
020021	015029	9	2593.4	999.9	9999	-7.2	3	-4	0.0	4	-1	-0.3	8	5	5
020021	015029	9	2909.1	999.9	9999	-6.0	3	-7	2.2	5	-5	0.0	8	5	1
020021	015029	9	3224.9	999.9	9999	-5.2	5	-8	-0.7	4	-4	-0.3	8	5	2
020021	015029	9	3540.6	10.9	285	-3.6	7	-9	1.9	6	-10	0.2	8	5	1
020021	015029	9	3856.3	9.3	284	-2.9	7	1	1.8	7	-1	0.3	8	5	1
020021	015029	9	4172.0	11.5	289	-3.7	7	-1	2.0	7	-1	0.5	8	5	-6
020021	015029	9	4487.7	11.5	291	-4.0	7	-7	1.5	7	-8	0.1	8	5	-7
020021	015029	9	4803.5	14.2	306	-4.9	7	-11	0.9	7	-9	0.6	8	5	-3
020021	015029	9	5119.2	17.3	298	-5.8	7	-6	2.1	7	-6	0.8	8	5	-5
020021	015029	9	5434.9	17.9	288	-6.4	7	-5	2.7	7	-7	0.3	4	5	-12
020021	015029	9	5750.6	999.9	9999	-7.3	6	-11	2.1	4	-13	-0.6	4	5	-15
020021	015029	9	6066.3	999.9	9999	9.2	4	-18	15.7	3	-17	-16.3	3	5	-20
020021	015029	9	6382.1	999.9	9999	7.4	3	-18	13.5	2	-15	-1.5	3	5	1
020021	015029	9	6697.8	999.9	9999	11.6	3	-17	-6.0	2	-18	6.4	3	5	-17
020021	015029	9	7013.5	999.9	9999	12.9	2	-16	16.9	2	-15	-7.4	3	5	-18
020021	015029	9	7329.2	999.9	9999	-8.2	2	-16	-11.6	2	-17	-12.1	3	5	-18
020021	015029	9	7644.9	999.9	9999	3.8	2	-20	12.1	3	-18	3.6	3	5	-17
020021	015029	9	7960.7	999.9	9999	-9.7	3	-17	-5.8	2	-17	-6.1	4	5	-20
020021	015029	9	8276.4	999.9	9999	13.4	4	-20	-16.5	3	-18	-13.8	3	5	-20
020021	015029	9	8592.1	999.9	9999	-6.5	3	-18	-5.8	3	-18	14.1	4	5	-19
020021	015029	9	8907.8	999.9	9999	-5.9	3	-19	-7.5	2	-18	-7.5	3	5	-18
020021	015029	9	9223.5	999.9	9999	13.2	3	-18	-17.3	3	-18	15.6	2	5	-17
020021	015029	9	9539.3	999.9	9999	13.3	3	-17	-9.9	3	-19	4.7	3	5	-17
020021	015029	9	9855.0	999.9	9999	-15.0	2	-19	5.6	2	-17	13.1	2	5	-18
020021	015029	9	10170.7	999.9	9999	16.5	3	-19	-5.3	4	-17	6.5	2	5	-18
021522	020521	9	383.4	999.9	9999	-8.3	5	23	-0.5	4	29	0.3	8	5	17
021522	020521	9	699.1	999.9	9999	-6.6	4	21	-0.9	5	27	0.2	8	5	27
021522	020521	9	1014.8	999.9	9999	-7.5	5	25	-0.5	4	21	0.0	8	5	18
021522	020521	9	1330.5	999.9	9999	-9.2	4	26	-1.4	5	31	0.0	8	5	29
021522	020521	9	1646.3	999.9	9999	-11.1	4	36	-1.5	4	28	-0.7	7	5	41
021522	020521	9	1962.0	999.9	9999	-11.3	4	32	1.0	5	11	-0.6	8	5	31
021522	020521	9	2277.7	999.9	9999	-0.3	3	2	0.5	5	7	-0.2	8	5	22
021522	020521	9	2593.4	999.9	9999	-7.1	5	4	0.2	4	5	0.0	8	5	11
021522	020521	9	2909.1	18.1	300	-6.9	7	-1	1.1	6	-2	0.0	8	5	7
021522	020521	9	3224.9	17.7	292	-6.6	8	-3	2.0	7	-2	-0.1	8	5	1
021522	020521	9	3540.6	13.6	282	-4.7	8	-5	2.4	7	-4	-0.1	8	5	2
021522	020521	9	3856.3	9.5	276	-3.0	8	1	2.0	7	0	0.0	8	5	3
021522	020521	9	4172.0	10.5	283	-3.6	8	2	1.9	7	1	0.0	8	5	-4
021522	020521	9	4487.7	11.5	300	-4.0	8	-4	1.2	7	-4	0.4	8	5	1
021522	020521	9	4803.5	14.2	307	-5.2	8	-8	0.5	7	-7	0.3	7	5	-6
021522	020521	9	5119.2	16.9	304	-6.3	8	-9	0.8	7	-10	0.1	8	5	-10

021522	020521	9	5434.9	16.9	298	-6.4	6	-14	1.3	6	5	0.0	6	5	-14
021522	020521	9	5750.6	18.7	278	-6.9	5	-15	3.1	6	-13	-0.8	5	5	-15
021522	020521	9	6066.3	999.9	9999	-9.7	2	-15	2.7	5	-16	-2.0	3	5	0
021522	020521	9	6382.1	999.9	9999	-10.0	2	2	2.8	2	4	-18.6	2	5	-20
021522	020521	9	6697.8	999.9	9999	11.0	3	-6	3.1	3	-6	9.1	3	5	-18
021522	020521	9	7013.5	999.9	9999	7.0	3	-18	1.8	3	22	5.9	3	5	-19
021522	020521	9	7329.2	999.9	9999	12.3	3	-15	-18.1	2	-18	-12.9	3	5	-19
021522	020521	9	7644.9	999.9	9999	14.4	2	-18	3.7	3	23	2.1	2	5	-17
021522	020521	9	7960.7	999.9	9999	-14.2	3	-11	5.9	3	13	14.8	2	5	-16
021522	020521	9	8276.4	999.9	9999	9.6	3	-15	3.2	3	2	9.5	3	5	-18
021522	020521	9	8592.1	999.9	9999	11.1	5	-18	-15.5	3	-14	8.4	2	5	-17
021522	020521	9	8907.8	999.9	9999	-14.9	4	-17	7.4	4	-18	-13.2	4	5	-18
021522	020521	9	9223.5	999.9	9999	-16.9	3	-16	7.0	2	-17	-16.0	2	5	-19
021522	020521	9	9539.3	999.9	9999	5.7	3	-18	-14.4	3	-16	8.0	2	5	-17
021522	020521	9	9855.0	999.9	9999	5.5	2	-18	5.2	3	-19	-3.7	4	5	-16
021522	020521	9	10170.7	999.9	9999	-11.1	5	-16	9.5	3	-17	15.1	4	5	-18

DATE: 11/08/1997 SITE NAME: RWP0005
LATITUDE: 28.50 LONGITUDE: -80.79 ELEVATION: 10 ft
AZIMUTH 1: 43 AZIMUTH 2: 133
NYQUIST: 19.6 kts

CTIMEZ	BTIMEZ	NM	HGT	WS	WD	RV1	NS1	SNR1	RV2	NS2	SNR2	VV	NSV	NMN	SNR
hhmmss	hhmmss	min	ft	kts	deg	kts	#	db	kts	#	db	kts	#	#	db
020029	015019	9	383.4	12.4	295	-1.7	6	8	-4.9	5	-7	-0.3	8	5	7
020029	015019	9	699.1	999.9	9999	1.0	6	33	-6.8	3	16	0.1	8	5	26
020029	015019	9	1014.8	999.9	9999	1.0	5	24	-7.7	3	30	0.5	8	5	42
020029	015019	9	1330.5	999.9	9999	4.8	4	31	-10.6	4	27	-0.9	5	5	46
020029	015019	9	1646.3	999.9	9999	2.0	4	20	-11.4	4	32	0.0	5	5	41
020029	015019	9	1962.0	999.9	9999	-1.9	5	22	-2.7	4	13	-0.1	5	5	30
020029	015019	9	2277.7	17.1	310	-0.2	5	6	-6.6	5	-2	0.0	7	5	10
020029	015019	9	2593.4	999.9	9999	-0.8	4	-7	-7.3	7	1	0.0	6	5	-2
020029	015019	9	2909.1	999.9	9999	-1.8	3	-11	-7.1	7	5	0.0	4	5	-12
020029	015019	9	3224.9	999.9	9999	-1.4	7	-11	-6.8	4	-1	0.1	6	5	-9
020029	015019	9	3540.6	999.9	9999	-1.7	4	-9	-4.7	7	-9	0.3	8	5	-6
020029	015019	9	3856.3	11.1	303	-0.4	6	-6	-3.9	8	-8	0.3	8	5	4
020029	015019	9	4172.0	20.6	292	0.0	8	-4	-4.6	7	-7	3.1	6	5	29
020029	015019	9	4487.7	999.9	9999	-0.8	3	-8	-5.2	4	-14	-15.4	2	5	-15
020029	015019	9	4803.5	999.9	9999	-10.4	2	-20	3.4	3	-19	1.9	3	5	10
020029	015019	9	5119.2	999.9	9999	-3.7	2	-6	12.9	2	-18	2.0	2	5	-11
020029	015019	9	5434.9	999.9	9999	-2.4	4	-14	13.4	2	-17	8.6	3	5	-17
020029	015019	9	5750.6	999.9	9999	-2.0	4	-7	17.0	2	-20	-11.5	2	5	-18
020029	015019	9	6066.3	999.9	9999	5.7	3	-20	-12.4	3	-16	-0.5	2	5	-20
020029	015019	9	6382.1	999.9	9999	-12.9	3	-18	17.5	3	-17	7.6	3	5	-18
020029	015019	9	6697.8	999.9	9999	17.8	3	-21	-14.1	2	-9	-8.0	4	5	-18
020029	015019	9	7013.5	999.9	9999	-16.2	3	-19	2.7	2	-17	-10.1	3	5	-18
020029	015019	9	7329.2	999.9	9999	17.5	3	-17	11.0	2	-18	-1.4	2	5	-19
020029	015019	9	7644.9	999.9	9999	-2.5	2	-19	-7.6	3	-18	16.6	3	5	-16
020029	015019	9	7960.7	999.9	9999	-13.6	3	-19	4.3	2	-18	-11.7	3	5	-17
020029	015019	9	8276.4	999.9	9999	-4.1	4	-20	12.7	2	-16	-6.0	4	5	-17
020029	015019	9	8592.1	999.9	9999	10.7	4	-18	12.1	2	-20	-8.9	3	5	-19
020029	015019	9	8907.8	999.9	9999	-6.5	4	-18	18.3	3	-17	5.9	4	5	-19
020029	015019	9	9223.5	999.9	9999	-4.8	3	-18	10.3	4	-18	-0.2	2	5	-19
020029	015019	9	9539.3	999.9	9999	17.4	3	-19	10.6	3	-20	-2.8	4	5	-18
020029	015019	9	9855.0	999.9	9999	2.8	3	-19	13.6	3	-11	-9.9	3	5	-19
020029	015019	9	10170.7	999.9	9999	-4.8	2	2	14.5	2	-6	-11.3	3	5	-17

021510	020515	9	383.4	999.9	9999	-2.6	5	23	-9.0	3	24	0.0	4	5	29
021510	020515	9	699.1	999.9	9999	0.3	6	31	-10.0	3	30	0.2	7	5	27
021510	020515	9	1014.8	999.9	9999	2.1	4	22	-1.0	4	35	0.4	8	5	26
021510	020515	9	1330.5	999.9	9999	1.1	4	18	-1.1	4	32	0.1	7	5	31
021510	020515	9	1646.3	999.9	9999	0.1	4	39	-1.9	3	14	0.0	7	5	25
021510	020515	9	1962.0	999.9	9999	0.0	4	34	-8.8	4	24	1.0	8	5	23
021510	020515	9	2277.7	999.9	9999	1.1	5	18	-2.2	4	19	1.3	7	5	21
021510	020515	9	2593.4	10.7	306	0.1	6	-1	-3.4	5	3	0.7	7	5	6
021510	020515	9	2909.1	999.9	9999	-2.0	5	11	-6.2	4	-8	0.8	4	5	-11
021510	020515	9	3224.9	14.2	287	-2.1	7	-11	-4.7	7	-10	0.3	7	5	-8
021510	020515	9	3540.6	11.7	297	-0.9	8	-7	-4.0	8	-5	0.3	8	5	-3
021510	020515	9	3856.3	10.5	300	-0.5	8	-2	-3.6	8	-4	0.3	8	5	-5
021510	020515	9	4172.0	13.8	297	-0.3	8	-4	-4.0	8	-7	1.2	7	5	-17
021510	020515	9	4487.7	11.1	298	-1.0	5	-9	-4.1	5	-19	5.8	2	5	-19
021510	020515	9	4803.5	999.9	9999	-8.1	4	-17	-7.3	3	-14	3.9	3	5	-18
021510	020515	9	5119.2	999.9	9999	-2.9	3	-7	13.7	3	-16	-0.5	4	5	-15
021510	020515	9	5434.9	999.9	9999	-3.9	3	-17	17.4	3	-23	9.1	3	5	-17
021510	020515	9	5750.6	999.9	9999	-3.3	4	-16	16.1	3	-18	-17.2	2	5	-19
021510	020515	9	6066.3	999.9	9999	14.1	2	-18	3.3	3	-17	9.6	3	5	-18
021510	020515	9	6382.1	999.9	9999	14.0	3	-17	-16.4	3	-17	10.1	2	5	-18
021510	020515	9	6697.8	999.9	9999	16.8	3	-18	18.0	4	-18	18.4	2	5	-17
021510	020515	9	7013.5	999.9	9999	-10.1	3	-18	11.9	2	-20	-11.2	3	5	-17
021510	020515	9	7329.2	999.9	9999	-6.0	2	-19	-18.4	2	-18	5.2	3	5	-19
021510	020515	9	7644.9	999.9	9999	-9.3	4	-21	10.4	4	-18	-3.9	3	5	-3
021510	020515	9	7960.7	999.9	9999	-5.2	2	-20	-17.0	5	-18	6.3	3	5	-20
021510	020515	9	8276.4	999.9	9999	-6.7	3	-16	-16.6	3	-17	-2.5	3	5	16
021510	020515	9	8592.1	999.9	9999	-4.8	4	-19	-15.8	3	-11	-2.7	2	5	0
021510	020515	9	8907.8	999.9	9999	-12.6	3	-18	-17.2	2	-2	-19.0	2	5	-16
021510	020515	9	9223.5	999.9	9999	14.8	2	-18	-9.4	3	-19	-16.6	3	5	-16
021510	020515	9	9539.3	999.9	9999	6.6	4	-19	3.1	4	-17	-5.1	3	5	-19
021510	020515	9	9855.0	999.9	9999	17.4	3	-16	11.5	4	14	-10.6	3	5	-18
021510	020515	9	10170.7	999.9	9999	-14.1	2	-18	14.7	3	9	4.4	3	5	-17

Meteorological Tower Data

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD	TIDN
97312	20500	28.4338	80.5734	6			60		1
97312	20500	28.4338	80.5734	12	295	2.9			1
97312	20500	28.4338	80.5734	54	267	7.0	60		1
97312	20500	28.4443	80.5621	6			60	52	2
97312	20500	28.4443	80.5621	12	300	2.9			2
97312	20500	28.4443	80.5621	54	302	6.0	60	52	2
97312	20500	28.4443	80.5621	90	301	8.0			2
97312	20500	28.4443	80.5621	162	302	8.9			2
97312	20500	28.4443	80.5621	204	300	11.1	60	52	2
97312	20500	28.4443	80.5621	6			59	52	2
97312	20500	28.4443	80.5621	12	300	1.9			2
97312	20500	28.4443	80.5621	54	301	5.1	60	53	2
97312	20500	28.4443	80.5621	90	300	7.0			2
97312	20500	28.4443	80.5621	162	302	8.0			2
97312	20500	28.4443	80.5621	204	288	8.9	60	52	2
97312	20500	28.4598	80.5267	6			59		3
97312	20500	28.4598	80.5267	12	303	6.0			3
97312	20500	28.4598	80.5267	54	296	7.0			3
97312	20500	28.4466	80.5652	6					17
97312	20500	28.7435	80.7005	6			61	54	19
97312	20500	28.7435	80.7005	54	324	14.0			19
97312	20500	28.7975	80.7378	6			61	53	22
97312	20500	28.7975	80.7378	54	305	13.0			22
97312	20500	28.4721	80.5393	6					36
97312	20500	28.4721	80.5393	90	311	8.9			36
97312	20500	28.5622	80.5785	6					40
97312	20500	28.5622	80.5785	54	301	11.1			40
97312	20500	28.5836	80.5842	6					41
97312	20500	28.5836	80.5842	54	291	9.9			41
97312	20500	28.5130	80.5613	6			63	58	61
97312	20500	28.5130	80.5613	12	301	2.9			61
97312	20500	28.5130	80.5613	54	299	6.0	59	51	61
97312	20500	28.5130	80.5613	162	301	9.9			61
97312	20500	28.5130	80.5613	204	306	11.1	60	52	61
97312	20500	28.5130	80.5613	6			59	52	62
97312	20500	28.5130	80.5613	12	293	2.9			62
97312	20500	28.5130	80.5613	54	293	6.0	60	53	62
97312	20500	28.5130	80.5613	162	296	8.9			62
97312	20500	28.5130	80.5613	204	298	9.9	59	56	62
97312	20500	28.5358	80.5747	6			60		108
97312	20500	28.5358	80.5747	12	298	5.1			108
97312	20500	28.5358	80.5747	54	293	8.0	60		108
97312	20500	28.6141	80.6203	6			56		112
97312	20500	28.6141	80.6203	12	292	1.9			112
97312	20500	28.6141	80.6203	54	292	6.0	58		112
97312	20500	28.4048	80.6519	6			62	55	300
97312	20500	28.4048	80.6519	54	294	8.9			300
97312	20500	28.4600	80.5711	6			58		303
97312	20500	28.4600	80.5711	12	297	1.9			303
97312	20500	28.4600	80.5711	54	294	6.0	59		303
97312	20500	28.6027	80.6414	6			59		311
97312	20500	28.6027	80.6414	12	302	2.9			311
97312	20500	28.6027	80.6414	54	261	1.0	59		311
97312	20500	28.6105	80.6069	6					393

97312	20500	28.6105	80.6069	60	291	8.9	59	53	393
97312	20500	28.6057	80.6016	6			58	52	394
97312	20500	28.6057	80.6016	60	294	8.9	58	52	394
97312	20500	28.6294	80.6235	6					397
97312	20500	28.6294	80.6235	60	292	8.9	58	52	397
97312	20500	28.6248	80.6182	6			58	52	398
97312	20500	28.6248	80.6182	60	292	8.9	58	52	398
97312	20500	28.4586	80.5923	6			60		403
97312	20500	28.4586	80.5923	12	305	5.1			403
97312	20500	28.4586	80.5923	54	298	8.0	60		403
97312	20500	28.6062	80.6739	6			57		412
97312	20500	28.6062	80.6739	12	291	1.0			412
97312	20500	28.6062	80.6739	54	298	5.1	58		412
97312	20500	28.6586	80.6998	6			58		415
97312	20500	28.6586	80.6998	12	275	1.0			415
97312	20500	28.6586	80.6998	54	300	2.9	58		415
97312	20500	28.7055	80.7265	6			61	55	418
97312	20500	28.7055	80.7265	54	305	7.0			418
97312	20500	28.7755	80.8043	6			61	56	421
97312	20500	28.7755	80.8043	54	289	11.1			421
97312	20500	28.5158	80.6400	6			59		506
97312	20500	28.5158	80.6400	12	295	4.1			506
97312	20500	28.5158	80.6400	54	302	6.0	60		506
97312	20500	28.5623	80.6694	6			58		509
97312	20500	28.5623	80.6694	12	318	2.9			509
97312	20500	28.5623	80.6694	54	310	5.1	59		509
97312	20500	28.5986	80.6817	6					511
97312	20500	28.5986	80.6817	30	300	8.0			511
97312	20500	28.6160	80.6930	6			61	52	512
97312	20500	28.6160	80.6930	30	301	8.0			512
97312	20500	28.6307	80.7027	6					513
97312	20500	28.6307	80.7027	30	304	8.0			513
97312	20500	28.6431	80.7482	6			58		714
97312	20500	28.6431	80.7482	12	318	2.9			714
97312	20500	28.6431	80.7482	54	302	6.0	58		714
97312	20500	28.4632	80.6702	6			58		803
97312	20500	28.4632	80.6702	12	299	1.0			803
97312	20500	28.4632	80.6702	54	297	2.9	59		803
97312	20500	28.5184	80.6962	6			69		805
97312	20500	28.5184	80.6962	12	293	4.1			805
97312	20500	28.5184	80.6962	54	287	7.0	59		805
97312	20500	28.7464	80.8707	6			57	52	819
97312	20500	28.7464	80.8707	54	294	5.1			819
97312	20500	28.4079	80.7604	6			58	53	1000
97312	20500	28.4079	80.7604	54	291	7.0			1000
97312	20500	28.5272	80.7742	6			59	54	1007
97312	20500	28.5272	80.7742	54	276	7.0			1007
97312	20500	28.6056	80.8248	6			60	52	1012
97312	20500	28.6056	80.8248	54	301	5.1			1012
97312	20500	28.5697	80.5864	6			60	55	1101
97312	20500	28.5697	80.5864	12	302	6.0			1101
97312	20500	28.5697	80.5864	54	295	12.1	60	53	1101
97312	20500	28.5697	80.5864	162	305	14.0			1101
97312	20500	28.5697	80.5864	204	302	14.0	59	51	1101
97312	20500	28.5697	80.5864	6			60	54	1102
97312	20500	28.5697	80.5864	12	303	5.1			1102
97312	20500	28.5697	80.5864	54	292	11.1	60	52	1102

97312	20500	28.5697	80.5864	162	298	12.1			1102
97312	20500	28.5697	80.5864	204	298	12.1	59	51	1102
97312	20500	28.4843	80.7856	6			59	53	1204
97312	20500	28.4843	80.7856	54	283	2.9			1204
97312	20500	28.6445	80.9034	6					1215
97312	20500	28.4114	80.9284	6			56	51	1500
97312	20500	28.4114	80.9284	54	280	4.1			1500
97312	20500	28.4475	80.8538	6					1502
97312	20500	28.4960	80.8843	6					1605
97312	20500	28.4960	80.8843	54					1605
97312	20500	28.5583	80.9132	6					1609
97312	20500	28.6173	80.9581	6			56	55	1612
97312	20500	28.6173	80.9581	54	266	5.1			1612
97312	20500	28.6762	80.9987	6			58	54	1617
97312	20500	28.6762	80.9987	54	305	7.0			1617
97312	20500	28.5231	81.0100	6			57	52	2008
97312	20500	28.5231	81.0100	54	274	5.1			2008
97312	20500	28.6489	81.0693	6			56	52	2016
97312	20500	28.6489	81.0693	54	298	6.0			2016
97312	20500	28.4417	81.0291	6					2202
97312	20500	28.4417	81.0291	54					2202
97312	20500	28.6256	80.6571	6			57	52	3131
97312	20500	28.6256	80.6571	12	292	2.9			3131
97312	20500	28.6256	80.6571	54	302	6.0	58	51	3131
97312	20500	28.6256	80.6571	162	296	11.1			3131
97312	20500	28.6256	80.6571	204	297	12.1	58	51	3131
97312	20500	28.6256	80.6571	295	302	14.0			3131
97312	20500	28.6256	80.6571	394	299	15.0			3131
97312	20500	28.6256	80.6571	492	294	15.9	57	51	3131
97312	20500	28.6256	80.6571	6			57	52	3132
97312	20500	28.6256	80.6571	12	296	2.9			3132
97312	20500	28.6256	80.6571	54	304	6.0	58	52	3132
97312	20500	28.6256	80.6571	162	304	11.1			3132
97312	20500	28.6256	80.6571	204	308	12.1	58	51	3132
97312	20500	28.6256	80.6571	295	305	14.0			3132
97312	20500	28.6256	80.6571	394	309	15.0			3132
97312	20500	28.6256	80.6571	492	310	11.1	56	50	3132
97312	20500	28.3932	80.8211	6			59	53	9001
97312	20500	28.3932	80.8211	54	294	6.0			9001
97312	20500	28.3382	80.7321	6			59	54	9404
97312	20500	28.3382	80.7321	54	290	4.1			9404

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD	TIDN
97312	21000	28.4338	80.5734	6			59		1
97312	21000	28.4338	80.5734	12	287	2.9			1
97312	21000	28.4338	80.5734	54	266	8.0	60		1
97312	21000	28.4443	80.5621	6			60	52	2
97312	21000	28.4443	80.5621	12	301	2.9			2
97312	21000	28.4443	80.5621	54	307	7.0	60	52	2
97312	21000	28.4443	80.5621	90	307	8.9			2
97312	21000	28.4443	80.5621	162	306	11.1			2
97312	21000	28.4443	80.5621	204	305	12.1	60	52	2
97312	21000	28.4443	80.5621	6			59	52	2
97312	21000	28.4443	80.5621	12	300	2.9			2
97312	21000	28.4443	80.5621	54	304	6.0	60	53	2
97312	21000	28.4443	80.5621	90	305	8.0			2
97312	21000	28.4443	80.5621	162	305	9.9			2

97312	21000	28.4443	80.5621	204	291	9.9	60	52	2
97312	21000	28.4598	80.5267	6			59		3
97312	21000	28.4598	80.5267	12	310	5.1			3
97312	21000	28.4598	80.5267	54	299	8.0			3
97312	21000	28.4466	80.5652	6					17
97312	21000	28.7435	80.7005	6			61	55	19
97312	21000	28.7435	80.7005	54	322	11.1			19
97312	21000	28.7975	80.7378	6			61	54	22
97312	21000	28.7975	80.7378	54	304	12.1			22
97312	21000	28.4721	80.5393	6					36
97312	21000	28.4721	80.5393	90	312	8.0			36
97312	21000	28.5622	80.5785	6					40
97312	21000	28.5622	80.5785	54	299	11.1			40
97312	21000	28.5836	80.5842	6					41
97312	21000	28.5836	80.5842	54	288	11.1			41
97312	21000	28.5130	80.5613	6			63	58	61
97312	21000	28.5130	80.5613	12	303	2.9			61
97312	21000	28.5130	80.5613	54	303	7.0	59	51	61
97312	21000	28.5130	80.5613	162	302	12.1			61
97312	21000	28.5130	80.5613	204	310	13.0	60	52	61
97312	21000	28.5130	80.5613	6			59	52	62
97312	21000	28.5130	80.5613	12	295	2.9			62
97312	21000	28.5130	80.5613	54	296	7.0	59	53	62
97312	21000	28.5130	80.5613	162	297	11.1			62
97312	21000	28.5130	80.5613	204	300	11.1	59	56	62
97312	21000	28.5358	80.5747	6			60		108
97312	21000	28.5358	80.5747	12	297	5.1			108
97312	21000	28.5358	80.5747	54	294	8.0	60		108
97312	21000	28.6141	80.6203	6			56		112
97312	21000	28.6141	80.6203	12	290	1.9			112
97312	21000	28.6141	80.6203	54	290	6.0	58		112
97312	21000	28.4048	80.6519	6			62	55	300
97312	21000	28.4048	80.6519	54	294	9.9			300
97312	21000	28.4600	80.5711	6			57		303
97312	21000	28.4600	80.5711	12	290	1.9			303
97312	21000	28.4600	80.5711	54	293	5.1	59		303
97312	21000	28.6027	80.6414	6			59		311
97312	21000	28.6027	80.6414	12	304	2.9			311
97312	21000	28.6027	80.6414	54	300	4.1	58		311
97312	21000	28.6105	80.6069	6					393
97312	21000	28.6105	80.6069	60	288	8.0	58	53	393
97312	21000	28.6057	80.6016	6			57	52	394
97312	21000	28.6057	80.6016	60	293	8.0	58	52	394
97312	21000	28.6294	80.6235	6					397
97312	21000	28.6294	80.6235	60	293	8.9	58	52	397
97312	21000	28.6248	80.6182	6			58	52	398
97312	21000	28.6248	80.6182	60	290	8.0	58	52	398
97312	21000	28.4586	80.5923	6			60		403
97312	21000	28.4586	80.5923	12	301	5.1			403
97312	21000	28.4586	80.5923	54	295	8.0	60		403
97312	21000	28.6062	80.6739	6			57		412
97312	21000	28.6062	80.6739	12	297	1.9			412
97312	21000	28.6062	80.6739	54	299	4.1	58		412
97312	21000	28.6586	80.6998	6			57		415
97312	21000	28.6586	80.6998	12	280	1.9			415
97312	21000	28.6586	80.6998	54	307	1.9	58		415
97312	21000	28.7055	80.7265	6			61	55	418

97312	21000	28.7055	80.7265	54	309	7.0			418
97312	21000	28.7755	80.8043	6			61	56	421
97312	21000	28.7755	80.8043	54	291	9.9			421
97312	21000	28.5158	80.6400	6			59		506
97312	21000	28.5158	80.6400	12	298	2.9			506
97312	21000	28.5158	80.6400	54	305	5.1	60		506
97312	21000	28.5623	80.6694	6			58		509
97312	21000	28.5623	80.6694	12	317	2.9			509
97312	21000	28.5623	80.6694	54	308	5.1	59		509
97312	21000	28.5986	80.6817	6					511
97312	21000	28.5986	80.6817	30	302	8.0			511
97312	21000	28.6160	80.6930	6			61	52	512
97312	21000	28.6160	80.6930	30	300	8.9			512
97312	21000	28.6307	80.7027	6					513
97312	21000	28.6307	80.7027	30	306	8.0			513
97312	21000	28.6431	80.7482	6			58		714
97312	21000	28.6431	80.7482	12	311	1.9			714
97312	21000	28.6431	80.7482	54	302	8.0	58		714
97312	21000	28.4632	80.6702	6			58		803
97312	21000	28.4632	80.6702	12	305	1.0			803
97312	21000	28.4632	80.6702	54	297	2.9	58		803
97312	21000	28.5184	80.6962	6			69		805
97312	21000	28.5184	80.6962	12	298	4.1			805
97312	21000	28.5184	80.6962	54	292	7.0	59		805
97312	21000	28.7464	80.8707	6			57	52	819
97312	21000	28.7464	80.8707	54	296	5.1			819
97312	21000	28.4079	80.7604	6			58	53	1000
97312	21000	28.4079	80.7604	54	291	8.0			1000
97312	21000	28.5272	80.7742	6			59	54	1007
97312	21000	28.5272	80.7742	54	279	8.0			1007
97312	21000	28.6056	80.8248	6			60	52	1012
97312	21000	28.6056	80.8248	54	297	2.9			1012
97312	21000	28.5697	80.5864	6			60	55	1101
97312	21000	28.5697	80.5864	12	301	6.0			1101
97312	21000	28.5697	80.5864	54	294	11.1	60	53	1101
97312	21000	28.5697	80.5864	162	304	13.0			1101
97312	21000	28.5697	80.5864	204	301	13.0	59	51	1101
97312	21000	28.5697	80.5864	6			60	54	1102
97312	21000	28.5697	80.5864	12	304	5.1			1102
97312	21000	28.5697	80.5864	54	290	9.9	60	52	1102
97312	21000	28.5697	80.5864	162	296	12.1			1102
97312	21000	28.5697	80.5864	204	297	12.1	59	51	1102
97312	21000	28.4843	80.7856	6			58	53	1204
97312	21000	28.4843	80.7856	54	279	2.9			1204
97312	21000	28.6445	80.9034	6					1215
97312	21000	28.4114	80.9284	6			56	51	1500
97312	21000	28.4114	80.9284	54	285	4.1			1500
97312	21000	28.4475	80.8538	6					1502
97312	21000	28.4960	80.8843	6					1605
97312	21000	28.4960	80.8843	54					1605
97312	21000	28.5583	80.9132	6					1609
97312	21000	28.6173	80.9581	6			56	55	1612
97312	21000	28.6173	80.9581	54	272	5.1			1612
97312	21000	28.6762	80.9987	6			58	54	1617
97312	21000	28.6762	80.9987	54	301	7.0			1617
97312	21000	28.5231	81.0100	6			57	52	2008
97312	21000	28.5231	81.0100	54	277	5.1			2008

97312	21000	28.6489	81.0693	6			55	52	2016
97312	21000	28.6489	81.0693	54	297	5.1			2016
97312	21000	28.4417	81.0291	6					2202
97312	21000	28.4417	81.0291	54					2202
97312	21000	28.6256	80.6571	6			56	51	3131
97312	21000	28.6256	80.6571	12	287	2.9			3131
97312	21000	28.6256	80.6571	54	299	6.0	57	51	3131
97312	21000	28.6256	80.6571	162	297	11.1			3131
97312	21000	28.6256	80.6571	204	296	12.1	58	51	3131
97312	21000	28.6256	80.6571	295	303	15.0			3131
97312	21000	28.6256	80.6571	394	299	15.9			3131
97312	21000	28.6256	80.6571	492	295	16.9	57	51	3131
97312	21000	28.6256	80.6571	6			57	52	3132
97312	21000	28.6256	80.6571	12	287	2.9			3132
97312	21000	28.6256	80.6571	54	302	6.0	58	52	3132
97312	21000	28.6256	80.6571	162	305	11.1			3132
97312	21000	28.6256	80.6571	204	308	12.1	58	51	3132
97312	21000	28.6256	80.6571	295	306	14.0			3132
97312	21000	28.6256	80.6571	394	310	15.9			3132
97312	21000	28.6256	80.6571	492	311	15.9	57	50	3132
97312	21000	28.3932	80.8211	6			59	53	9001
97312	21000	28.3932	80.8211	54	294	5.1			9001
97312	21000	28.3382	80.7321	6			59	54	9404
97312	21000	28.3382	80.7321	54	290	5.1			9404

DAY	TIME	LAT	LON	Z	DIR	SPD	T	TD	TIDN
97312	21500	28.4338	80.5734	6			59		1
97312	21500	28.4338	80.5734	12	292	4.1			1
97312	21500	28.4338	80.5734	54	266	8.0	60		1
97312	21500	28.4443	80.5621	6			59	52	2
97312	21500	28.4443	80.5621	12	309	2.9			2
97312	21500	28.4443	80.5621	54	313	5.1	60	52	2
97312	21500	28.4443	80.5621	90	311	8.0			2
97312	21500	28.4443	80.5621	162	308	9.9			2
97312	21500	28.4443	80.5621	204	308	11.1	59	52	2
97312	21500	28.4443	80.5621	6			59	52	2
97312	21500	28.4443	80.5621	12	310	2.9			2
97312	21500	28.4443	80.5621	54	311	5.1	60	53	2
97312	21500	28.4443	80.5621	90	308	7.0			2
97312	21500	28.4443	80.5621	162	307	8.0			2
97312	21500	28.4443	80.5621	204	294	8.0	59	52	2
97312	21500	28.4598	80.5267	6			59		3
97312	21500	28.4598	80.5267	12	311	6.0			3
97312	21500	28.4598	80.5267	54	301	8.0			3
97312	21500	28.4466	80.5652	6					17
97312	21500	28.7435	80.7005	6			61	55	19
97312	21500	28.7435	80.7005	54	318	11.1			19
97312	21500	28.7975	80.7378	6			60	54	22
97312	21500	28.7975	80.7378	54	300	14.0			22
97312	21500	28.4721	80.5393	6					36
97312	21500	28.4721	80.5393	90	309	8.9			36
97312	21500	28.5622	80.5785	6					40
97312	21500	28.5622	80.5785	54	299	9.9			40
97312	21500	28.5836	80.5842	6					41
97312	21500	28.5836	80.5842	54	290	9.9			41
97312	21500	28.5130	80.5613	6			63	58	61
97312	21500	28.5130	80.5613	12	297	4.1			61

97312	21500	28.5130	80.5613	54	300	7.0	59	51	61
97312	21500	28.5130	80.5613	162	299	11.1			61
97312	21500	28.5130	80.5613	204	308	13.0	59	52	61
97312	21500	28.5130	80.5613	6			59	52	62
97312	21500	28.5130	80.5613	12	289	2.9			62
97312	21500	28.5130	80.5613	54	294	6.0	59	53	62
97312	21500	28.5130	80.5613	162	294	9.9			62
97312	21500	28.5130	80.5613	204	300	11.1	59	56	62
97312	21500	28.5358	80.5747	6			60		108
97312	21500	28.5358	80.5747	12	294	4.1			108
97312	21500	28.5358	80.5747	54	292	8.0	60		108
97312	21500	28.6141	80.6203	6			56		112
97312	21500	28.6141	80.6203	12	294	1.9			112
97312	21500	28.6141	80.6203	54	291	6.0	57		112
97312	21500	28.4048	80.6519	6			61	55	300
97312	21500	28.4048	80.6519	54	294	11.1			300
97312	21500	28.4600	80.5711	6			57		303
97312	21500	28.4600	80.5711	12	303	1.9			303
97312	21500	28.4600	80.5711	54	295	5.1	59		303
97312	21500	28.6027	80.6414	6			59		311
97312	21500	28.6027	80.6414	12	304	4.1			311
97312	21500	28.6027	80.6414	54	307	7.0	58		311
97312	21500	28.6105	80.6069	6					393
97312	21500	28.6105	80.6069	60	287	8.0	58	53	393
97312	21500	28.6057	80.6016	6			57	52	394
97312	21500	28.6057	80.6016	60	293	8.0	58	52	394
97312	21500	28.6294	80.6235	6					397
97312	21500	28.6294	80.6235	60	292	7.0	58	52	397
97312	21500	28.6248	80.6182	6			57	52	398
97312	21500	28.6248	80.6182	60	290	8.0	58	52	398
97312	21500	28.4586	80.5923	6			60		403
97312	21500	28.4586	80.5923	12	308	5.1			403
97312	21500	28.4586	80.5923	54	300	8.9	60		403
97312	21500	28.6062	80.6739	6			57		412
97312	21500	28.6062	80.6739	12	294	1.0			412
97312	21500	28.6062	80.6739	54	299	5.1	58		412
97312	21500	28.6586	80.6998	6			57		415
97312	21500	28.6586	80.6998	12	269	1.9			415
97312	21500	28.6586	80.6998	54	295	2.9	57		415
97312	21500	28.7055	80.7265	6			61	54	418
97312	21500	28.7055	80.7265	54	310	8.0			418
97312	21500	28.7755	80.8043	6			60	56	421
97312	21500	28.7755	80.8043	54	292	11.1			421
97312	21500	28.5158	80.6400	6			59		506
97312	21500	28.5158	80.6400	12	296	2.9			506
97312	21500	28.5158	80.6400	54	308	4.1	59		506
97312	21500	28.5623	80.6694	6			58		509
97312	21500	28.5623	80.6694	12	317	4.1			509
97312	21500	28.5623	80.6694	54	308	6.0	58		509
97312	21500	28.5986	80.6817	6					511
97312	21500	28.5986	80.6817	30	301	8.0			511
97312	21500	28.6160	80.6930	6			61	52	512
97312	21500	28.6160	80.6930	30	300	8.0			512
97312	21500	28.6307	80.7027	6					513
97312	21500	28.6307	80.7027	30	307	8.0			513
97312	21500	28.6431	80.7482	6			58		714
97312	21500	28.6431	80.7482	12	310	2.9			714

97312	21500	28.6431	80.7482	54	302	8.0	58		714
97312	21500	28.4632	80.6702	6			58		803
97312	21500	28.4632	80.6702	12	306	1.0			803
97312	21500	28.4632	80.6702	54	300	2.9	58		803
97312	21500	28.5184	80.6962	6			69		805
97312	21500	28.5184	80.6962	12	292	4.1			805
97312	21500	28.5184	80.6962	54	295	8.0	59		805
97312	21500	28.7464	80.8707	6			57	52	819
97312	21500	28.7464	80.8707	54	295	4.1			819
97312	21500	28.4079	80.7604	6			57	53	1000
97312	21500	28.4079	80.7604	54	296	7.0			1000
97312	21500	28.5272	80.7742	6			59	54	1007
97312	21500	28.5272	80.7742	54	278	7.0			1007
97312	21500	28.6056	80.8248	6			59	52	1012
97312	21500	28.6056	80.8248	54	288	4.1			1012
97312	21500	28.5697	80.5864	6			60	55	1101
97312	21500	28.5697	80.5864	12	303	6.0			1101
97312	21500	28.5697	80.5864	54	296	11.1	60	53	1101
97312	21500	28.5697	80.5864	162	304	12.1			1101
97312	21500	28.5697	80.5864	204	300	13.0	58	51	1101
97312	21500	28.5697	80.5864	6			60	54	1102
97312	21500	28.5697	80.5864	12	304	5.1			1102
97312	21500	28.5697	80.5864	54	292	9.9	60	52	1102
97312	21500	28.5697	80.5864	162	296	11.1			1102
97312	21500	28.5697	80.5864	204	297	11.1	58	52	1102
97312	21500	28.4843	80.7856	6			58	53	1204
97312	21500	28.4843	80.7856	54	273	4.1			1204
97312	21500	28.6445	80.9034	6					1215
97312	21500	28.4114	80.9284	6			56	51	1500
97312	21500	28.4114	80.9284	54	284	4.1			1500
97312	21500	28.4475	80.8538	6					1502
97312	21500	28.4960	80.8843	6					1605
97312	21500	28.4960	80.8843	54					1605
97312	21500	28.5583	80.9132	6					1609
97312	21500	28.6173	80.9581	6			56	55	1612
97312	21500	28.6173	80.9581	54	271	5.1			1612
97312	21500	28.6762	80.9987	6			58	54	1617
97312	21500	28.6762	80.9987	54	300	7.0			1617
97312	21500	28.5231	81.0100	6			57	52	2008
97312	21500	28.5231	81.0100	54	274	4.1			2008
97312	21500	28.6489	81.0693	6			55	52	2016
97312	21500	28.6489	81.0693	54	289	5.1			2016
97312	21500	28.4417	81.0291	6					2202
97312	21500	28.4417	81.0291	54					2202
97312	21500	28.6256	80.6571	6			56	51	3131
97312	21500	28.6256	80.6571	12	287	2.9			3131
97312	21500	28.6256	80.6571	54	299	6.0	57	51	3131
97312	21500	28.6256	80.6571	162	296	11.1			3131
97312	21500	28.6256	80.6571	204	297	12.1	58	51	3131
97312	21500	28.6256	80.6571	295	303	15.0			3131
97312	21500	28.6256	80.6571	394	300	16.9			3131
97312	21500	28.6256	80.6571	492	296	16.9	57	50	3131
97312	21500	28.6256	80.6571	6			57	52	3132
97312	21500	28.6256	80.6571	12	288	2.9			3132
97312	21500	28.6256	80.6571	54	302	6.0	57	52	3132
97312	21500	28.6256	80.6571	162	305	11.1			3132
97312	21500	28.6256	80.6571	204	308	12.1	58	51	3132

97312	21500	28.6256	80.6571	295	306	15.0			3132
97312	21500	28.6256	80.6571	394	311	15.9			3132
97312	21500	28.6256	80.6571	492	312	15.9	56	50	3132
97312	21500	28.3932	80.8211	6			58	53	9001
97312	21500	28.3932	80.8211	54	298	6.0			9001
97312	21500	28.3382	80.7321	6			59	54	9404
97312	21500	28.3382	80.7321	54	291	4.1			9404